5-5-2018

Psychosocial Correlates of Medication Adherence Among College-Aged Women

Lauren Strainge
lauren.strainge@uconn.edu

Psychosocial Correlates of Medication Adherence Among College-Aged Women

Lauren R. Strainge

M.A., Teachers College, Columbia University, 2014

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

at the

University of Connecticut

2018

APPROVAL PAGE

Master of Science Thesis

Psychosocial Correlates of Medication Adherence Among College-Aged Women

Presented by

Lauren R. Strainge, M.A.

Major Advisor_____
Dean G. Cruess, Ph.D

Associate Advisor_____
Amy A. Gorin, Ph.D

Associate Advisor_____
Howard Tennen, Ph.D

University of Connecticut

2018

University of Connecticut

2018

TABLE OF CONTENTS

Introduction

The United States is an increasingly medicated society. Nearly 70% of Americans report prescription medication use in the past year (Zhong et al., 2013), with more than 4.3 billion prescriptions dispensed in 2015 alone (IMS Institute for Healthcare Informatics, 2016). Recent trends in prescription drug development, direct-to-consumer advertising, and expansions in health insurance and prescription drug coverage have fueled dramatic increases in prescribing (National Center for Health Statistics, 2016). As a result, since the early 1990s, the proportion of Americans reporting prescription medication use during the past 30 days has increased by more than ten percentage points among young and middle-aged adults (National Center for Health Statistics [NCHS], 2016), with even greater increases among older Americans (NCHS, 2016; Qato, Wilder, Schumm, Gillet, & Alexander, 2016). Between 2013 and 2015, prescription drug spending in the United States grew by nearly 20%, totaling more than $425 billion in 2015 (IMS Institute for Healthcare Informatics, 2016). Spending is predicted to increase by an additional 46%, to more than $620 billion, within the next three years (IMS Institute for Healthcare Informatics, 2016).

These changes have not impacted all Americans equally. Mounting evidence suggests that women are significantly more likely to be prescribed medication than their male counterparts, even after adjusting for a number of gender-based health differences (Anthony et al., 2008; Skoog, Midlöv, Borgquist, Sundquist, & Halling, 2014; Thorell, Skoog, Zielinski, Borgquist, & Halling, 2012; Zhong et al., 2013). Approximately 47% of women between the ages of 15 and 44 report prescription medication use in the past 30 days, compared to just 26% of same-aged men (National Center for Health Statistics, 2016; Tinker, Broussard, Frey, & Gilboa, 2015). For nearly all drug classes, women receive more prescriptions than men (Anthony

et al., 2008; Schroder et al., 2016; Zhong et al., 2013), although these trends vary somewhat across the lifespan (Thorell et al., 2012; Zhong et al., 2013).

For young women, the prescription gap appears to be even more pronounced. All ten of the most commonly prescribed drug classes for individuals under 30 are dispensed to women at higher rates than men, a trend that emerges in late adolescence and disappears by middle age (Schroder et al., 2016; Zhong et al., 2013). While contraceptive use and gender differences in morbidity seem to account for a large proportion of this difference (Skoog et al., 2014; Zhong et al., 2013), additional factors, such as gender differences in doctor's prescribing patterns, may also be at play (Skoog et al., 2014). As overall prescribing rates continue to increase, more and more young women find themselves taking prescription medication on a regular basis (Tinker et al., 2015).

Medication Adherence

Defining Adherence. Increases in prescription medication use and the disproportionate rates of prescribing to young women emphasize the importance of medication adherence within this population. Defined by the World Health Organization (WHO) as "the extent to which a person's behavior – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider," adherence is crucial for successful disease management (WHO, 2003, p. 3). Medication adherence is a key component of overall treatment adherence and involves taking medicines as prescribed. Failure to do so constitutes poor or suboptimal adherence, which can take several forms: under-adherence (taking less medication than prescribed), over-adherence (taking more medication than prescribed), or failing to follow provider instructions regarding how (e.g., with food) and when (e.g., morning, every four hours) to take medication. Although the term 'compliance' was often used in older

literature to reflect the same concept, more recent literature has tended to use the term 'adherence' to avoid the implication of patient fault and reflect the active involvement of the patient in agreeing with provider recommendations (Hughes, 2004; Topinkova, Baeyens, Michel, & Lang, 2012). For the purpose of clarity, this paper will exclusively use the term 'adherence.'

The Adherence Problem. Overwhelming evidence indicates that failure to take medication as prescribed can lead to a plethora of negative short- and long-term health outcomes. Former U.S. Surgeon General C. Everett Koop described the problem succinctly: "Drugs don't work in people who don't take them" (Osterberg & Blaschke, 2005, p.487). Suboptimal medication adherence is associated with poorer health, decreased quality of life, undesirable health consequences, and substantial increases in morbidity and mortality across numerous illnesses (Chowdhury et al., 2013; DiMatteo, Giordani, Lepper, & Croghan, 2002; Doggrell, 2010; Hughes, 2004; Nunes et al., 2009; Simpson et al., 2006; Viswanathan et al., 2012). Failure to adequately adhere to prescription medication has been estimated to account for at least 10% of annual hospitalizations and approximately 125,000 medical deaths each year (Peterson, Takiya, & Finley, 2003; Viswanathan et al., 2012). In the United States, more than 1.53 million pregnancies can be attributed to imperfect adherence to oral contraceptives every year, representing nearly one-quarter of all pregnancies and more than half of all unintended pregnancies (Finer & Zolna, 2011; Guttmacher-Institute, 2016; Trussell et al., 2013a). Overall, poor adherence contributes to an estimated $290 billion in unnecessary annual healthcare spending in the United States alone (Golay, 2011; Nasseh, Frazee, Visaria, Vlahiotis, & Tian, 2012; The New England Healthcare Institute, 2009).

Unfortunately, suboptimal adherence to medication is incredibly common, particularly among patients with chronic health conditions, such as asthma, cancer, and diabetes (Chowdhury

et al., 2013; Coleman et al., 2012; Haynes, McDonald, Garg, & Montague, 2002; Rolnick, Pawloski, Hedblom, Asche, & Bruzek, 2013; Tomaszewski et al., 2014), and among those who require daily medication, such as women taking oral contraceptives (Molloy, Graham, & McGuinness, 2012; Trussell et al., 2013b; Wu, Kusunoki, Ela, & Barber, 2016). Nearly 55% of Americans report regular medication use (IMS Institute for Healthcare Informatics, 2016). However, an estimated 60% of prescriptions dispensed in the United States are not taken as prescribed, and more than half of patients taking long-term medication cease treatment within the first year, despite on-going need (Bosworth, 2011; Haynes et al., 2002; O'Connor, 2006). Large-scale studies of pharmacy records indicate that 20-30% of prescriptions are never filled at all (Fischer et al., 2010; Gadkari & McHorney, 2010). This proportion is even higher for newly prescribed long-term medications (Gadkari & McHorney, 2010).

Adherence in Young Women

Young women may be at particular risk for poor adherence and subsequent negative outcomes. Convergent evidence from diverse patient populations suggests that overall, women are less likely to adhere to prescription medication than men (Chen, Lee, Liang, & Liao, 2014; Lee & Khan, 2016; Pai & Ostendorf, 2011; Puskas et al., 2011; Zhang & Meltzer, 2016). Furthermore, risk factors for poor adherence seem to differ somewhat between men and women, and suboptimal adherence among female patients is more likely to go unnoticed by healthcare providers (Chen et al., 2014; Holt et al., 2013; Puskas et al., 2011; Schuman-Olivier, Weiss, Hoeppner, Borodovsky, & Albanese, 2014). Notably, the gender discrepancy in medication adherence diminishes significantly among the elderly (Holt et al., 2013), suggesting that young women may be at disproportionate risk (Puskas et al., 2011).

This is underscored by generally high rates of poor adherence among adolescents and young adults. Compared to children, middle aged adults, and the elderly, young adults aged 18 to 29 are significantly less likely to adhere to prescription medications, particularly when taken for extended periods of time (Becker, Dezii, Burtcel, Kawabata, & Hodder, 2002; Ettenhofer et al., 2009; Hinkin et al., 2004; Hood, Peterson, Rohan, & Drotar, 2009). As many as three-quarters of young adults taking prescription drugs routinely fail to adhere to their medication, even with the knowledge that poor adherence may dramatically increase the risk of serious health problems (Fredericks et al., 2008; Hilliard, Wu, Rausch, Dolan, & Hood, 2013; Hood et al., 2009; McGrady, Williams, Davies, & Pai, 2014). For example, adolescent and young adult transplant recipients are four times more likely to be non-adherent to critical immunosuppressant drugs than adult recipients (Fredericks, 2008). Additional literature indicates that transition to college and corresponding increases in independence are particularly associated with declines in medication adherence (Butow et al., 2010; McGrady, Williams, Davies, & Pai, 2014; McGrady et al., 2015), even among previously adherent individuals (Butow et al., 2010; Hilliard, Wu, Rausch, Dolan, & Hood, 2013; Hood et al., 2009; McGrady, Peugh, & Hood, 2014; McGrady, Brown, & Pai, 2015). Given that young women are prescribed more medication than young men, and that women generally are at greater risk for poor adherence, young women in particular seem to be disproportionately vulnerable to suboptimal adherence.

Health Outcomes. Although young women are prescribed medication at lower rates compared to middle-aged and older individuals (Morgan & Kennedy, 2010), the potential outcomes associated with poor adherence are no less detrimental. Evidence suggests that non-adherent young adults are approximately two times and a half times more likely to be hospitalized than age-matched adherent patients, and are more likely to need additional surgery

then their adherent peers (Goodhand et al., 2013; McGrady & Hommel, 2013). Poor adherence is also associated with greater use of emergency health services and more frequent emergency department visits (McGrady & Hommel, 2013).

In addition to increased healthcare usage, suboptimal adherence in adolescence and young adulthood has also been linked to poor disease management, greater illness progression, increased risk of adverse health events (e.g., transplant rejection/graft loss, unintended pregnancy, cancer relapse), and poorer health-related quality of life (Adolescent and Young Adult Oncology Progress Review Group, 2014; Axelsson et al., 2009; Bhatia et al., 2012; Canner et al., 2013; Dobbels et al., 2010; Kennard et al., 2004; McCormick King et al., 2014). For example, Type I diabetes control is lowest among individuals aged 18 and 19 (Bryden et al., 2001; Bryden, Dunger, Mayou, Peveler, & Neil, 2003), and young women are at even greater risk for serious diabetes complications during this period (Bryden et al., 2001; Pyatak, Florindez, & Weigensberg, 2013). Similarly, young adults with asthma are significantly more likely to have unmet asthma control needs than other age groups (Friedman, Navaratnam, & McLaughlin, 2010; Scal, Davern, Ireland, & Park, 2008). Among young adult recipients of pediatric kidney transplantations, more than 35% of patients lose a functioning kidney transplant within three years after transitioning out of pediatric care (Harden et al., 2012), with the greatest risk for graft loss due to poor immunosuppressant adherence among women aged 17 to 24 (Foster et al., 2015; Van Arendonk et al., 2013). In addition to the increased morbidity associated with chronic disease, women aged 18 to 24 also have the highest prevalence of unintended pregnancy of any age group, contributing to significant medical and emotional burden (Finer & Zolna, 2011, 2014). As many as half of these unintended pregnancies are attributable to poor adherence to oral contraceptives (Finer & Zolna, 2014; Trussell et al., 2013a). Given the increased risk and

morbidity associated with poor adherence, it is perhaps unsurprising that non-adherent young adults also report lower health-related quality of life than their adherent peers (Axelsson et al., 2009; Fredericks et al., 2008; Rothenberger, Becker, Breuer, & Döpfner, 2011). Furthermore, health-related quality of life is reliably lower in young women than young men (Axelsson et al., 2009; Fredericks et al., 2008; Sundberg, Palmqvist, Tunsater, & Toren, 2009).

Beyond the detrimental physical, emotional, and social effects of such serious health outcomes, poor adherence among young adults also contributes to substantially higher mortality rates among young adults with chronic illness than other age groups. For example, cancer survival rates for children under 15 are nearly two times higher than survival rates for adolescents and young adults, which is believed to reflect a significant drop in adherence to oral chemotherapies and prophylactic antibiotics among young adults (Adolescent and Young Adult Oncology Progress Review Group, 2014; Canner et al., 2013; Kennard et al., 2004). Similarly, death rates due to asthma are four times higher among adolescents and young adults than among children (Bergstrom et al., 2008), and pediatric transplant recipients are at greatest risk for post-transplant mortality between ages 16 and 20 (Hayes, McCoy, Whitson, Mansour, & Tobias, 2015).

The serious health consequences and societal costs associated with poor adherence among adolescents and young adults generally, and young women in particular, highlights the need for a better understanding of women's adherence patterns and identification of factors associated with poor adherence within this at-risk population. While a great deal of research has been dedicated to identifying risk factors that can act as potential barriers to optimal adherence among middle-aged and older adults (Gellad, Grenard, & Marcum, 2011; Topinkova et al., 2012; Yap, Thirumoorthy, & Kwan, 2015), comparatively little attention has been paid to adherence

patterns among young adults (Macdonell, Carcone, Naar-King, Gibson-Scipio, & Lam, 2015; Pyatak et al., 2013). This is true despite evidence that the period of life between ages 18 and 29, often referred to as "emerging adulthood," appears to be a critical stage for medication adherence and the development of other long-term health behaviors.

Emerging Adulthood

First described by Arnett in the early 2000s, emerging adulthood refers to a "prolonged period of independent role exploration during the late teens and twenties…distinguished by relative independence from social roles and from normative expectations" (Arnett, 2000, p. 469). A growing body of literature supports the concept of emerging adulthood as a distinct period of neurobiological, psychological, and social development marked by high levels of self-focus and increasing autonomy (Arnett, Žukauskiene, & Sugimura, 2014; Arnett, 2000; Henin & Berman, 2016; Tanner, 2016). This period is marked by transition and flux; emerging adults typically leave their home and parents, explore new social networks, and experience high levels of educational and occupational change (Arnett et al., 2014; Arnett, 2000).

Emerging Health Behaviors. In addition to these life changes, emerging adulthood is also a critical period for health behavior development (Cho, 2016; Daw, Margolis, & Wright, 2017; Frech, 2009; Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008). A number of risky health behaviors, including tobacco use, binge drinking, risky sexual behavior, and poor nutrition become increasingly prominent during emerging adulthood (Centers for Disease Control and Prevention, 2016; Daw et al., 2017; Frech, 2009; Nelson et al., 2008). While these behaviors are detrimental in their own right, mounting evidence suggests that problematic health behaviors in young adulthood can also set up trajectories for increasingly poor health later in life (Arria et al., 2016; Daw et al., 2017; Nelson et al., 2008).

For certain individuals, adoption of poor health behaviors in emerging adulthood sets the stage for unhealthy habits and increasing difficulty with health maintenance later in life (Cho, 2016; Daw et al., 2017; Frech, 2009; Mumford, Liu, Hair, & Yu, 2013). Trajectories from emerging to later adulthood are different for men and women (Howard, Galambos, & Krahn, 2010). Although young women experience slower declines in health behaviors during emerging adulthood (Frech, 2009), women who engage in poor health behaviors during this period seem to be more likely to experience negative health outcomes later in life (Mumford et al., 2013).

Medication adherence. Although no studies to date have explored trajectories in medication adherence from emerging adulthood into later life, these findings suggest that poor adherence during this critical period may set up problematic habits that prove detrimental across the lifespan. Given the fact that emerging adults, particularly young women, are at increased risk for poor medication adherence (Butow et al., 2010; Hilliard et al., 2013; McGrady et al., 2015; Pai & Ostendorf, 2011), understanding the risk factors associated with poor adherence in this population is of critical importance.

Risk Factors for Poor Adherence

Given the importance of emerging adulthood as a distinct developmental period, it is reasonable to suppose that young adults face a distinct set of risk factors for poor adherence. Certain prominent risk factors affecting children and adolescents remain relevant during emerging adulthood, while additional risk factors identified among middle-aged and older adults seem to take on increasing importance.

For example, evidence suggests that the higher-order cognitive processes (e.g., planning, problem-solving, decision-making) known as executive functions play an important role in successful medication adherence among children and adolescents (Bagner, Williams, Geffken,

Silverstein, & Storch, 2007; Duke & Harris, 2014; Garvie et al., 2017; McNally, Rohan, Pendley, Delamater, & Drotar, 2010; O'Hara & Holmbeck, 2013). In contrast, by middle adulthood, executive functions are more solidly developed and show much less consistent association with adherence (Baek, 2014; Barclay et al., 2007; Diamond, 2014; Ettenhofer et al., 2009; Schutte, 2006). Notably, executive functions continue to develop through emerging adulthood (Diamond, 2014), suggesting that executive dysfunction may be an important risk factor for poor adherence in young adults (Gutierrez-Colina et al., 2016).

At the same time, risk factors that are important among middle-aged adults but less prominent among pediatric populations, such as alcohol use, substance abuse, and poor sleep, seem to emerge as increasingly important for medication adherence young adults (Butow et al., 2010; Griffith, Kumaraswami, Chrysanthopoulou, Mattocks, & Clark, 2017; Pyatak et al., 2013; Riegel et al., 2011). Similarly, with increasing independence, emerging adults are typically increasingly responsible for managing their own treatment (Pai & Ostendorf, 2011; Shifren, Furnham, & Bauserman, 2003). As such, factors related to medication regimen (e.g., number of medications, prescriber instructions, side effects) and personal beliefs about medications, may become more important without the guidance or oversight of a parent (Ingersoll & Cohen, 2008; Labig Jr., Zantow, & Peterson, 2005; McQuaid et al., 2012; Schaefer et al., 2017).

Finally, a number of variables seem to be relevant for medication adherence across the lifespan. For example, psychological distress (e.g., depression, stress) is a prominent risk factor for poor adherence for both children and adolescents, and middle-aged and older adults (Bender, 2006; Desai & Oppenheimer, 2011; Fontanella, Bridge, Marcus, & Campo, 2011; Mausbach, Schwab, & Irwin, 2015; Uthman, Magidson, Safren, & Nachega, 2014). Similarly, poor social support and perceived barriers to care negatively impact adherence regardless of age (Danziger-

Isakov et al., 2016; George & Shalansky, 2007; Graça Pereira, Berg-Cross, Almeida, & Cunha Machado, 2008; Magrin et al., 2015; Miller & DiMatteo, 2013). These risk factors also appear to be important for medication adherence during emerging adulthood (Bryden et al., 2003; Macdonell et al., 2015; Pai & Ostendorf, 2011; Pyatak et al., 2013), although their impact among college-aged women has not been fully established. Young adulthood is a period of increased risk for the emergence of mood and anxiety disorders, with young women disproportionately affected, as well as a period of significant changes in social networks and healthcare engagement (Cho, 2016; Tanner, 2016). As such, these relationships may function differently for young women than other groups.

While converging lines of evidence suggest a unique constellation of risk factors may be particularly relevant for college-aged women taking daily prescription medications, little research has focused on adherence in this population. Those studies conducted to date have tended to focus on specific medical populations (e.g., emerging adults with asthma, women taking oral contraceptives) rather than the intersection of two important demographic risk factors, age and gender.

Current Study. Given the disproportionate prescribing rates for young women and the serious short- and long-term health consequences associated with poor adherence, it is important to identify how various risk factors may function in this population. As such, the current student aimed to explore the psychosocial correlates of poor medication adherence among a sample of college-aged women.

Demographic, treatment-related, and physical and mental health-related variables were assessed. No demographic variables were expected to correlate with poor adherence. In keeping with the literature discussed above, it was hypothesized that women who reported suboptimal

adherence would also report: 1) more complex medication regimens, 2) more negative beliefs about medications, 3) more perceived barriers to taking medication as prescribed, 4) higher levels of psychological distress, 5) less social support, and 6) greater alcohol and substance use, 7) poorer sleep quality, and 8) greater executive dysfunction.

Methods

Participants

Participants were recruited from among the participant pool composed of students in introductory psychology courses, at a large public research university in New England. 1,928 students completed the participant pool pre-screening questionnaire to determine eligibility. Participants were eligible to complete the study if they 1) were age 18 years or older, 2) could read and understand English, 3) self-identified as female, and 4) were currently prescribed a daily mediation. Daily prescription medication use was assessed via self-report with the question: "Are you currently prescribed a medication (including birth control) for daily use? Do not include vitamins or supplements unless they are prescribed by a healthcare provider." Participants who answered in the affirmative and met the above criteria were deemed eligible. 632 students met inclusion criteria for the study out of a total of 1,243 female students (50.8%). Of those, 186 women (29.4%) participated in the study. Three individuals (1.6%) did not report their gender and were subsequently excluded, leaving a final sample of 183 women.

Procedures

Recruitment occurred from February 2017 to April 2017. Eligible participants accessed the study online via a unique URL, which connected them to the Sona-Systems participant pool management software (Sona-Systems, Ltd., 2017). Prior to any study procedures, participants were presented with an information page detailing the purpose and potential risks of the study.

Information was presented in chunks to facilitate understanding, and participants indicated their consent by selecting "I agree" on the final page.

Following informed consent, participants completed study questionnaires via Qualtrics, a software tool to electronically collect and manage research data (Qualtrics, 2017). Participants remained anonymous throughout study procedures and received class credit in compensation. The survey concluded with local and national mental health resources for any participants who may have wanted additional support for symptoms of depression, stress, and/or substance use. The university's Internal Review Board approved all study procedures and measures.

Measures

Demographics. Participants reported their age, race, ethnicity, sexual orientation, year in school, relationship/marital status, family income, living situation, employment status, health insurance, and religious affiliation.

Medication Use. Participants also provided detailed information regarding their daily prescription medication use. For each of their daily medications, participants reported the medication name, dosage, number of times taken per day, and means of administration. Means of administration were selected from a list of common administration methods: by mouth in pill form; by mouth in liquid form; inhaled (e.g., inhaler, nasal spray); topical or onto skin; via injection; or via another method which participants described. For each medication, participants indicated whether there were additional instructions associated with taking that medication by selecting any relevant items from a list of common medication instructions (e.g., taking medication at specific time of day, taking medication with food). This list included an option to indicate uncertainty about whether their medication came with additional instructions. Participants were also provided with space to include any instructions for their medication that

were not included on the list. These questions provided a comprehensive assessment of the nature and complexity of participants' medication regimens.

To assess the duration of their prescription, participants also reported how long they had been taking each of their prescription medications, in months. They also indicated the primary reason for taking each of their medications. Reason for prescription was selected from a list of common health concerns, including birth control; a chronic medical condition; ADD/ADHD; a mental health condition; sleep; or for another reason, which the participant described. Participants who indicated their medication was primarily for a chronic medical condition or mental health condition were asked to specify their condition. This list included an option to indicate uncertainty about the purpose of their medication.

After completing these questions for one medication, participants reported whether or not they were prescribed an additional daily prescription medication. If they reported another medication, they were prompted to complete the same assessment for each medication until they indicated no additional daily prescription medications. Once participants reported no additional medications, the survey advanced to the next questionnaire.

Medication Adherence. Participants completed the Morisky Medication Adherence Scale-8 (MMAS-8; Morisky, Ang, Krousel-Wood, & Ward, 2008), a brief, eight-item scale that has been widely used to measure medication adherence among a variety of populations, including adolescents and young adults (Goodhand et al., 2013; Tan, Patel, & Chang, 2014). Items address a number of common reasons for sub-optimal adherence, such as: "Do you sometimes forget to take your pills?", "Have you ever cut back or stopped taking your medicine without telling your doctor because you felt worse when you took it?", and "Over the past two weeks, were there any days when you did not take your medicine?" Participants responded either

yes or no to each question, yielding a possible score from zero to eight, with higher scores indicative of more adherence problems. The MMAS-8 is psychometrically sound, with good sensitivity, specificity, concurrent validity, and internal consistency (Morisky et al., 2008; Oliveira-Filho, Barreto-Filho, Neves, & Lyra Junior, 2012). In the current study, Cronbach's alpha for the MMAS-8 was acceptable at 0.71.

Beliefs About Medication. Participants also completed the Beliefs about Medications Questionnaire (BMQ; Horne, Weinman, & Hankins, 1999). The BMQ consists of 18 items that load onto four factors: Specific-Concern (regarding the participant's concerns about the long-term or disruptive effects of their current medication); Specific-Necessity (regarding the perceived necessity of the medication to the participant's health); General-Overuse (regarding the participant's beliefs that medications are overused by doctors); and General-Harm (regarding the participant's beliefs that medicines are generally harmful/addictive and should not be taken continuously). Each item is rated on a one (Strongly Disagree) to five (Strongly Agree) scale, with higher scores indicating more negative views toward medications. The BMQ has been found to have good reliability, criterion-related, and discriminant validity, and has proven useful in a number of clinical populations (Horne et al., 1999). Cronbach's alpha for the BMQ in our study was good, $\alpha = 0.87$.

Perceived Barriers to Adherence. Participants completed the Adolescent Medication Barriers Scale (ABMS), a 17-item self-report measure that assessed perceived barriers to adherence, including disease frustration, ingestion issues, and regimen complexity (Simons & Blount, 2007). Items included, "I feel that taking my medicine gets in the way of my activities," and, "I'm not organized about when and how to take the medication." Items were rated on a scale from one (Strongly Disagree) to five (Strongly Agree), with higher scores on each item

indicating stronger influence/importance of that specific barrier. Total barriers were assessed by summing the number of items on which participants indicated a score of four or more (agree or strongly agree). The AMBS has demonstrated high reliability and validity, and is particularly well-suited for use with young adults (Simons & Blount, 2007). Internal consistency in the current study was excellent, $\alpha = 0.91$.

Depression. Participants completed the Center for Epidemiological Studies – Depression scale (CES-D), a self-report, 20-item measure of depressive symptoms (Radloff, 1977). Items include: "I felt that everything I did was an effort," "I thought my life had been a failure," and "I felt hopeful for the future" (reverse-coded). The CES-D assesses depressed mood in the previous week on a four-point scale ranging from zero (Rarely/None of the time (less than one day)) to three (Most/ All of the time (5-7 days)). Higher scores on the scale indicate increased presence of depressive symptoms. Scores of 16 or higher are considered indicative of clinically significant depression. The instrument has demonstrated high internal consistency, as well as strong construct validity (Eaton, Muntaner, Smith, Tien, & Ybarra, 2004; Radloff, 1977). Internal consistency in the current study was good (Cronbach's alpha = 0.81).

Perceived Stress. Participants also reported their level of perceived stress. The Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) was developed to measure the degree to which situations in one's life are perceived as stressful. Participants were asked to consider the last month when responding to ten questions, such as "How often have you been upset because of something that happened unexpectedly?" and "How often have you felt that you were on top of things?" (reverse-coded). Participants respond to questions on a five-point scale ranging from "never" to "very often." The PSS is not a diagnostic instrument, thus there are no cut-off scores

and comparisons are sample dependent. The scale has demonstrated good test-retest reliability (r = 0.85; Cohen et al., 1983). Cronbach's alpha was excellent ($\alpha = 0.90$) for the current sample.

Social Support. Participants completed the twelve-item Interpersonal Support Evaluation List (ISEL; Cohen & Hoberman 1983) to measure their perceptions of social support. Items included, "If I wanted to have lunch with someone, I could easily find someone to join me," and "I feel that there is no one I can share my most private worries and fears with" (reverse-scored). Questions were answered on a four-point scale ranging from "definitely true" to "definitely false." The ISEL is not a diagnostic measure, so no clinical thresholds are applied to total scores. When using a college sample, the scale has demonstrated adequate validity and reliability properties (Cohen & Hoberman, 1983). Internal consistency in our sample was good, at $\alpha = 0.80$.

Alcohol Use. The ten-item Alcohol Use Disorders Identification Test (AUDIT) assessed for alcohol dependence and problematic alcohol use. Participants self-reported their drinking behaviors (e.g., "How often do you have a drink containing alcohol?", "How often do you have six or more drinks on one occasion?"), as well as any alcohol-related functional impairment (e.g., "How often in the last year have you failed to do what was normally expected of you because of drinking?"). Questions are anchored on a five-point Likert scale, with responses for most questions ranging from "never" to "daily or almost daily." The psychometric properties of the AUDIT are favorable, with a high degree of internal consistency (Reinert & Allen, 2007). In our sample, AUDIT internal consistency was acceptable (Cronbach's alpha = 0.72).

Substance Use. Participants self-reported their substance use with the Drug Abuse Screening Test-10 (DAST-10; Skinner, 1982). The DAST-10 is a ten-item measure used to assess drug use and related problems. Items include, "Are you unable to stop abusing drugs when you want to?" and "Do you ever feel bad or guilty about your drug use?" For each question,

participants indicate either “yes” or “no,” yielding a score from zero to ten, with higher scores consistent with more drug-related problems. Scores of six or more are consistent with substantial problems related to drug abuse, and scores of three or more warrant additional clinical attention. Internal consistency for the DAST-10 in our sample was low, $\alpha = 0.62$.

Sleep Problems. Participants’ sleep was assessed using the DSM-5 Level 2 Sleep Disturbance Measure (PROMIS Health Organization and PROMIS Cooperative Group, 2012) and the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The DSM-5 Level 2 Sleep Disturbance Measures consists of eight self-report items that assess sleep quality and disturbances over the past week. Items describe various problems with sleep (e.g., “I had difficulty falling asleep,” “I had difficulty staying asleep”), and are rated on a one (Never/Not at all bothered) to five (Always/Very much bothered) scale. Higher scores indicate greater symptom frequency and interference, and can be converted to T-scores to allow for standardized severity ratings (PROMIS Health Organization and PROMIS Cooperative Group, 2012). In the current study, Cronbach’s alpha was acceptable, $\alpha = 0.72$.

The PSQI is a self-rated nine-item questionnaire that assesses sleep patterns, quality, and disturbances and provides a rating from ‘poor’ to ‘good’ across seven domains: sleep duration, sleep disturbances, sleep latency, functional impairment due to disturbed sleep, sleep efficiency, overall sleep quality, and the use of medications to sleep. The PSQI also provides a global score and thresholds for determining clinical significance. It has been used extensively for sleep research in a wide range of community and clinical populations, has high internal consistency and good construct validity (Buysse et al., 1989; Buysse et al., 2008). Internal consistency for the PSQI in the current study was acceptable (Cronbach’s alpha = 0.74).

Executive Functioning. Participants completed the adult self-report version of the Behavior Rating Inventory of Executive Function (BRIEF-A; Roth, Isquith, & Gioia, 2014). The BRIEF-A consists of 75 items, each of which describes an issue related to poor executive functioning, and asks how often in the last month each issue has been a problem for the participant – "Never (0)", "Sometimes (1)", or "Often (2)". The BRIEF-A yields two broad domain scores. The Behavioral Regulation domain includes subscales that tap into the participant's ability to regulate their own behavior. The Metacognition domain includes subscales that deal with the participant's ability to exert effortful control over her own mental processes in order to organize her activities and environment. These two domain scores can also be summed to yield an overall Global Executive Composite (GEC) score. The BRIEF-A has strong psychometric properties and has been found to be useful in young adult populations (Ciszewski, Francis, Mendella, Bissada, & Tasca, 2014; Roth et al., 2014; Roth, Lance, Isquith, Fischer, & Giancola, 2013). In our sample, Cronbach's alpha was excellent at $\alpha = 0.97$.

Data Management and Analyses

Study data was collected and stored online using Qualtrics research software (Qualtrics, 2017). At the end of data collection, data was downloaded to a secure password-protected computer. Before conducting any analyses, data was cleaned for clarity and consistency. Participant-reported reasons for taking a medication were verified and re-coded as appropriate. For example, if a participant reported that they were taking a medication for "Another Reason," and reported that their medication was for hypothyroidism, their reason was re-coded as "A Chronic Medical Condition." A complete summary of data re-coding is presented in Appendix A.

All analyses were conducted using SPSS Statistics software package, version 24.0. Sample characteristics were assessed using frequency counts and descriptive statistics. Demographic, medication-related, and behavioral/psychosocial risk factors were assessed using Pearson's correlation coefficients, independent-samples t-tests, and one-way analyses of variance (ANOVAs). Preliminary analyses were conducted to confirm statistical assumptions of normality, linearity, and equality of variance, as appropriate. Finally, a series of hierarchical linear regressions were conducted to assess the predictive validity of medication-related and behavioral/psychosocial risk factors after controlling for demographic variables that were significantly related to adherence. Significance was assessed at the $p < 0.05$ level for all analyses, except where Holm's sequential Bonferroni procedure was applied, as necessary, to adjust for multiple comparisons (Holm, 1979).

Results

Sample Demographics

Participant demographics are summarized in Table 1. The mean age of participants was 19.38 years (SD = 2.44, range = 18-49). As previously noted, 100% of participants self-identified as female. The majority (73.2%) of participants identified as White or European American, 13.7% identified as Hispanic or Latina, 12% identified as Asian or Asian American, 8.7% identified as Black or African American, 0.5% identified as Native American, and 2.2% identified their race as "Something Else." 9.8% of participants selected more than one racial/ethnic identity. A large majority (93.4%) of the sample identified as straight or heterosexual. An additional 4.9% of the sample identified as bisexual, 0.5% identified as lesbian, and the remaining 1% of participants responded either that they were unsure of their sexual

orientation or endorsed their sexual orientation as “Something Else.” The sample was composed primarily of freshmen (39.3%) and sophomores (34.4%). An additional 20.2% of participants were juniors, 5.5% were seniors, and 0.5% reported being in their fifth year at the university. The majority (83.7%) of the sample reported living on campus, with the remaining participants fairly evenly divided between those living off-campus (8.7%) and those living at home with family (8.2%). Most participants (61.1%) reported a family income greater than $80,000 per year. 10.6% reported an annual family income between $60,000 and $80,000, 11.7% reported a family income between $40,000 and $60,000, 7.8% reported a family income between $20,000 and $40,000, 4.4% reported a family income between $10,000 and $20,000, and 4.4% reported a family income of less than $10,000 per year. 99% of participants reported health insurance coverage; 65% were covered through family, 15.8% were covered through work, 3.3% were covered through school, and 14.9% were covered through a public insurance provider (e.g., Medicaid). The remaining 1% of participants did not report their health insurance coverage. The majority of participants reported some employment; 39.9% reported having a part-time job, 37.7% reported having a summer job, and 0.5% reported working full-time. 21.3% reported that they were not employed, and an additional 0.5% did not report their employment status.

Medication Usage

Participant medication usage is presented in Table 2. Participants reported taking an average of 1.48 daily prescription medications (SD = 0.85, range = 1-7). The modal number of daily medications was one (65% of participants). An additional 24% of participants reported taking two daily medications, 6.6% reported taking three, 1.6% reported taking four, and 0.5% reported taking five and seven, respectively, for a total of 265 distinct medications across the entire sample. Medication data was missing for three participants. Participants reported

medication regimens involving an average of 2.66 medication-related instructions per participant (SD = 2.19, range 1-13), with an average of 1.81 (SD = 1.14) instructions per medication. A minority (13%) of participants reported being bothered by unpleasant side effects of their medication.

More than three-quarters (78.7%) of the sample reported taking daily medication for birth control. 14.8% reported taking medication for a chronic medical condition, 16.9% reported taking medication for a mental health condition, 6.6% reported taking medication for ADD/ADHD, 1.6% reported taking medication for sleep, and 5.5% reported taking medication for another reason. No participants reported being unsure of the primary reason for taking their medication. Medications were overwhelmingly administered orally, in pill form (94% of all 265 medications). An additional 0.4% were administered orally in liquid form, 2.6% were inhaled, 1.9% were administered topically, and 0.8% were administered via injection. 0.4% were administered via another method. Medication characteristics are presented in Table 3.

Clinical Features

Descriptive statistics for the scales assessing potential risk factors are presented in Table 4. For scales with clinical thresholds, the number and percentage of participants who reported clinically-relevant levels of distress are also reported in Table 4. Participants reported generally low levels of concerns about the long-term effects of their own medications (BMQ Specific Concerns: M = 9.06, SD = 4.10) and low perceived necessity of their medications (BMQ Specific Necessity: M = 10.87, SD = 5.57). They also reported generally positive attitudes toward the use (BMQ General Overuse: M = 10.87, SD = 3.62) and safety (BMQ General Harm: M = 7.95, SD = 2.60) of medications. Perceived barriers to adherence were also relatively low, although there was significant variability in the sample (M = 2.70, SD = 2.96, range = 0-11).

Participants reported elevated levels of depressive symptoms (M = 19.72, SD = 12.13), and more than 46% scored above the clinical cut-off indicative of major depression. Participants also reported elevated stress levels (M = 17.67, SD = 7.65). Depression symptoms and perceived stress were highly correlated ($r = 0.802$, $p < 0.001$), and were therefore condensed into a single composite "Distress" scale for subsequent analyses. This composite scale consisted of the summed z-scores of both scales. On average, participants in our sample reported moderate levels of perceived social support (M = 31.54, SD = 5.40).

Participants reported low levels of alcohol-related problems on average (M = 6.13, SD = 3.81), although approximately 25% scored above the clinical cut-off for potential alcohol abuse. Substance use and related problems were rare in our sample (M = 0.060, SD = 0.99), with only 5.6% of participants meeting clinical thresholds for drug-related concerns.

On average, participants reported minimal sleep disturbance (M = 20.19 (T-score of 51), SD = 5.24), and a minority (5.6%) reported clinically relevant levels of sleep problems. Overall sleep quality on the PSQI was rated in the "fairly good" range, and daytime dysfunction was rated as "only a slight problem."

Overall, global executive functioning in our sample was within normal limits based on participants' age (M = 109.19 (T-score = 52), SD = 27.24). Average scores for the domains of Behavioral Regulation (M = 47.77 (T-score = 53), SD = 12.75) and Metacognition (M = 61.34 (T-score = 51), SD = 16.22) were also in the average range. 13% of participants endorsed clinically significant levels of executive dysfunction.

Medication Adherence

Participants endorsed an average of 3.30 (SD = 1.71, range 0-8) out of a total of eight possible problems related to adhering to their daily prescription medication, and 94% of

participants endorsed at least one problem with adherence. A breakdown of reported problems is presented in Table 5. The most commonly endorsed adherence problems included sometimes forgetting to take one's medication (72.7%), forgetting to bring one's medication when leaving home (59.6%), having missed at least one dose within the past two weeks (43.7%), and struggling to remember to take one's medication (40.9%). Participants also reported feeling hassled for having to take their medication (22.4%), stopping their medication because it made them feel worse (18.6%), stopping their medication because them felt better (10.9%), and failing to take their medication the day before (7.7%).

Demographic Risk Factors. Relationships between adherence problems and demographic variables were assessed using Pearson's correlation coefficients, independent samples t-tests, and ANOVAs, as appropriate. Age was not significantly correlated with MMAS-8 scores (r = -0.077; p = n.s.). Because women were able to select more than one racial/ethnic identity, separate independent samples t-tests were conducted for each racial/ethnic identity, comparing women who endorsed that identity with women who did not. Women who identified as Hispanic/Latina reported significantly more problems with adherence than women who did not identify as Hispanic/Latina (t (176) = -2.191, p = 0.019). No other racial or ethnic identity was associated with greater adherence problems (all p's > 0.05). Similarly, adherence scores did not significantly differ by sexual orientation, year in school, living situation, family income, health insurance coverage or employment status (all p's > 0.05).

Medication-Related Risk-Factors. Relationships between adherence problems and medication-related variables were assessed using independent samples t-tests and Pearson's correlation coefficients. Because women were able to select more than one reason for taking their medication, separate t-tests were conducted for each primary reason, comparing women

who endorsed taking at least one medication for a given reason to those who did not endorse taking any medications for that reason. None of the reported reasons were associated with greater MMAS-8 scores (all *p*'s > 0.05).

Due to the high proportion of women in our sample taking oral contraceptives, an ANOVA was conducted to assess for potential differences in adherence between women taking medication for birth control only (n = 93), women taking medications for birth control and other reasons (n = 49), and women taking medications other than birth control (n = 36). There were no significant differences in adherence problems across these groups (F (2, 174) = 1.432, p = n.s.)

Regimen Complexity. Correlation coefficients for medication-related variables are reported in Table 6. A complete correlation matrix of study variables is included in Appendix B. Neither participants' total number of medications (r = -0.045; p = n.s.) nor the total number of instructions associated with their medication regimens (r = -0.005; p = n.s.) were significantly correlated with MMAS-8 scores.

Beliefs about Medication. Problems with adherence were significantly associated with self-reported concerns about one's own medications (r = 0.225; p = 0.004); women who reported more concerns about their medication (e.g., "I sometimes worry about the long-term effects of my medicine") also reported more problems adhering to their daily prescription. However, adherence problems were not significantly related to the perceived necessity of one's own medications (r = 0.038; p = n.s.), or to general concerns about medication overuse (r = 0.014; p = n.s.) or harmfulness (r = 0.060; p = n.s.).

Perceived Barriers to Adherence. There was a medium-to-large correlation between the total number of self-reported barriers to adherence and MMAS-8 scores (r = 0.453; p < 0.001),

such that women who reported more barriers (e.g., "I do not want other people to notice me taking the medicine") also reporting more problems with adherence.

Behavioral and Psychosocial Risk Factors. Relationships between MMAS-8 scores and behavioral and psychosocial variables were also assessed using Pearson's correlation coefficients. Results are presented in Table 7.

Psychological Distress. Psychological distress significantly correlated with MMAS-8 scores (r = 0.264; p = 0.001). Women who reported more severe distress (i.e., depressive symptoms and perceived stress) also reported more problems adhering to their medication. The effect size for the association between distress and adherence was small. Women who reported clinically significant levels of depressive symptoms reported significantly more problems with adherence (t (172) = 3.642, p < 0.001).

Social Support. A small, negative correlation between social support and MMAS-8 scores problems was observed (r = -0.205; p = 0.008). Women who reported greater social support reported significantly fewer problems with medication adherence.

Alcohol and Substance Use. There was a small, positive association between alcohol use and medication adherence (r = 0.167; p = 0.042), but no significant relationship between adherence and substance use problems (r = 0.103; p = n.s.). Women who reported clinically significant levels of alcohol-related or substance use-related problems did not report significantly more problems with adherence (alcohol: t (166) = -1.550, p = n.s.; substance use: t(170)= -1.009, p = n.s.).

Sleep Problems. Greater sleep disturbance, as measured by the DSM-5 Sleep Disturbance Measure, was significantly associated with more adherence problems (r = 0.151; p = 0.047). The effect size for the association between sleep problems and adherence was also small. Women

who reported clinically significant levels of sleep disturbance did not report significantly more problems with adherence (t (173) = -0.943, p = n.s.).

Executive Functioning. Greater executive dysfunction was significantly associated with more adherence problems (r = 0.317; $p < 0.001$); women who reported more difficulties with executive functioning also reported more problems with medication adherence. The association between executive functioning and adherence was of medium effect size.

Predicting Adherence. A series of hierarchical linear regressions predicting MMAS-8 scores from medication-related and behavioral/psychosocial risk factors controlled for ethnicity (i.e., Hispanic/Latina vs. not Hispanic/Latina). Separate analyses were conducted for each risk factor found to be significantly correlated with adherence, as discussed above. Beta-weights and ΔR^2 values for the addition of each risk factor to the model are listed in Table 8. Due to multiple tests, significance is indicated based on adjusted α levels.

Concerns about the long-term effects of one's own medications significantly predicted higher MMAS-8 scores (β = 0.207, p = 0.007), and accounted for an additional 4.2% of the variance in adherence problems beyond the variance associated with demographics (F(2, 163) = 6.995, p = 0.001). Self-reported barriers to adherence also significantly predicted MMAS-8 scores (β = 0.401, $p < 0.001$), and accounted for an additional 16% of the variance in adherence problems after controlling for ethnicity (F(2, 166) = 19.537, $p < 0.001$). Similarly, high psychological distress significantly predicted high MMAS-8 scores (β = 0.250, p = 0.001), and accounted for an additional 6.1% of the variance in adherence scores after controlling for demographics (F(2, 166) = 8.894, $p < 0.001$). Social support was also a significant predictor, with higher perceived social support predicting fewer problems with adherence (β = -0.193, p = 0.011). Social support scores accounted for an additional 3.7% of the variance in MMAS-8

scores after controlling for demographics ($F(2, 166) = 5.563$, $p = 0.005$). In contrast to the initial correlational findings, alcohol use ($\beta = 0.155$, p = n.s.) and sleep disturbance ($\beta = 0.135$, p = n.s.) were no longer significant predictors. However, global executive functioning was a significant predictor of MMAS-8 scores ($\beta = 0.300$, $p < 0.001$), and accounted for an additional 8.7% of the variance in adherence problems after controlling for demographics ($F(2, 148) = 9.046$, $p < 0.001$).

Results for the inclusion of these variables in a single regression model are presented in Table 9. When the identified risk factors were included in a single step of the regression model, after controlling for Hispanic/Latina ethnicity, the added variables accounted for an additional 26.1% of the variance in adherence problems ($\chi^2 = 5.728$, $p < 0.001$). Perceived barriers ($\beta = 0.416$, $p < 0.001$) and global executive functioning ($\beta = 0.269$, $p = 0.024$) remained as significant predictors. All other included variables were non-significant when entered simultaneously.

Discussion

The current study sought to evaluate the psychosocial correlates of poor adherence to daily prescription medication among women at a large public research university in New England. Specifically, the study assessed the prevalence of adherence problems among this emerging adult population, and identified psychosocial variables associated with poor adherence.

Consistent with previous findings, self-reported problems with adherence were the norm in our sample, with nearly all participants (94%) reporting at least one problem adhering to their medication. Unintentional non-adherence due to forgetting was cited most frequently (90%), although a significant portion of the sample also reported intentional non-adherence (23%).

Women in our sample who identified as Hispanic/Latina reported significantly more adherence problems than women who did not identify as Hispanic or Latina. Although we did

not anticipate that demographic variables would be associated with adherence problems, this finding is consistent with previous research in which Hispanic/Latina identity has been associated with poor treatment adherence among clinical samples of middle-aged and older adults (González & Borrayo, 2011; Mansyur, Rustveld, Nash, & Jibaja-Weiss, 2015; Rashid et al., 2017).

The hypothesized relationship between more complex medication regimens and more problems with adherence was not observed in our sample. This finding is likely a reflection of the relatively low medication burden in our sample; most participants reported taking just one daily medication, with relatively few associated instructions. In contrast, most adherence studies among young adults focus on clinical populations with complex medication regimens, and show significant associations between regimen complexity and adherence problems (Foster & Pai, 2014; Hanghøj & Boisen, 2014; Ingersoll & Cohen, 2008). Thus, our results suggest that among community samples of young women, regimen complexity may only become relevant to adherence when medication burdens are particularly high.

We also hypothesized that negative beliefs about medications would significantly predict greater problems with adherence. This hypothesis was only partially supported in our sample. Only specific concerns about the safety and long-term effects of one's own medications significantly predicted poor adherence; beliefs about the necessity of one's own medications and general concerns about medication overuse or harmfulness were unrelated to self-reported adherence problems. This was true despite the fact that participants reported generally low levels of concerns about their own medications. These findings demonstrate that young women's concerns about their medications seem to play a more important role in adherence than other negative medication beliefs, and suggest that even low levels of specific concerns in the context

of generally positive medication beliefs may negatively impact adherence in emerging adulthood.

Consistent with our hypothesis, the number of self-reported barriers to adherence significantly predicted problems with adherence, even after controlling for Hispanic/Latina ethnicity. When added to the regression model, perceived barriers accounted for considerable proportion (16%) of the variability in adherence scores, and perceived barriers remained a significant predictor even when risk factors were tested simultaneously. These results are consistent with previous studies of adherence in young adults (Danziger-Isakov et al., 2016; Lee et al., 2014; Simons & Blount, 2007), and underscore the importance of young women's perceptions about the difficulty of adhering to their medications on their actual health behaviors.

Our prediction that higher levels of psychological distress would significantly predict poor adherence was also supported in our sample. Distress scores accounted for approximately 6% of the variance in adherence problems, after controlling for ethnicity, and women who scored above clinical cut-offs on a measure of depressive symptoms reported significantly more problems taking their medications as prescribed. These findings add to the existing literature identifying psychological distress and depression as major risk factors for poor medication adherence in emerging adulthood (Butow et al., 2010; Hilliard et al., 2013; Penkower et al., 2003; Pyatak et al., 2013), and suggests that this relationship is important in community samples of young women.

As hypothesized, lower levels of social support were also predictive of greater problems with adherence. Perceived social support accounted for a small but significant proportion (3.7%) of the variance in adherence scores after controlling for Hispanic/Latina identity. Thus, although emerging adulthood is often a period of considerable social flux (Arnett et al., 2014), our data

indicate that support networks remain important for successful medication adherence throughout this developmental stage.

Contrary to our predictions, elevated levels of alcohol and substance use were not risk factors for poor adherence in our sample after controlling for demographics, even to the extent that women who reported clinically significant levels of alcohol and substance use problems did significantly differ on adherence scores. This may be due to the relatively low levels of alcohol-related problems and substance use in our sample. The lack of a significant relationship between alcohol and substance use and problems with adherence may also reflect distinct associations of health behaviors among college students. Drinking culture is pervasive on American college campuses (White & Hingson, 2013), and alcohol consumption patterns among college students typically differ significantly from consumption patterns among other populations. For example, baseline levels of alcohol use are significantly higher among college students than individuals in other age groups, and drinking typically occurs in social context (Arria et al., 2016). As such, the relationship between alcohol use and poor adherence to medication observed in other young adult populations, particularly clinical populations, may not hold true for a community sample of college women (Bender, 2006; Griffith et al., 2017; Pyatak et al., 2013).

Similarly, the hypothesized relationship between sleep problems and poor adherence was not significant in our sample after controlling for ethnicity, and clinically significant levels of sleep disturbance did not significantly impact problems with adherence. As with the lack of association between alcohol use and adherence, this finding may be attributable to the minimal sleep disturbances reported by women in our sample, which may have precluded a robust relationship. Given that sleep patterns among college students also tend to vary significantly from patterns among non-college adults (Lund, Reider, Whiting, & Prichard, 2010), it may also

be the case that these relationships simply do not hold in among college women as they do in other populations (Riegel et al., 2011).

Greater executive dysfunction was shown to be a significant predictor of adherence problems in our sample, consistent with study hypotheses. Despite the fact that, on average, women in our sample fell within normative limits for executive functioning, those who reported more EF difficulties also reported more problems with medication adherence. Global executive functioning scores accounted for a significant proportion of variation in adherence after controlling for demographics, and executive functioning remained a significant predictor even when risk factors were tested simultaneously. These findings support the idea that executive functioning makes a significant contribution to medication adherence in emerging adulthood, even among a community sample with minimal reported dysfunction.

To our knowledge, this is the first study to establish these psychosocial/adherence relationships among a community sample of young women. These findings suggest a unique constellation of risk factors at play for college-aged women taking daily medication, which does not map clearly onto the risk factors for children and younger adolescents or middle-aged and older adults. Thus, our results lend additional support to the concept of emerging adulthood as a distinct period of life for health-related behaviors. Furthermore, the particular pattern of risk factors in our sample indicates that age and gender may interact in unique ways, such that findings related to medication adherence in other populations may not generalize to college women. This is particularly important given the high rates of prescribing (more than half of the 1,243 women in the participant pool reported taking a daily medication), the negative outcomes associated with poor adherence among young women, and the potential for poor adherence in emerging adulthood to set up problematic adherence trajectories into later life.

Limitations

Despite the novelty and clinical importance of these findings, a number of limitations are worth noting. First, as with most adherence studies among young adults, data in this study are cross-sectional, and preclude any claims of causality. It may be the case that poor adherence to medication has a significant negative impact on psychosocial factors (e.g., psychological distress, sleep, executive functioning), or that the relationship between adherence and these variables is bidirectional. Furthermore, it is not clear how the variables assessed here may influence adherence over time. Future studies should consider collecting longitudinal data to address this significant gap in the literature and may better inform clinical interventions.

Second, this study was conducted online, and relied wholly on self-report. While this methodology allowed for broader reach and the inclusion of women who may not have been able or willing to participate in a face-to-face study, the online format also limited the extent to which we were able to regulate the environment in which participants completed the survey, which may increase the risk for inconsistent engagement or lack of attention to the questions. In addition, self-reports can be prone to recall errors and social desirability bias. These factors can lead to underestimates of adherence problems when compared to more objective measures (Lehmann et al., 2014; MacLaughlin et al., 2005; Shi et al., 2010; Williams et al., 2013). The self-report nature of the additional measures also raises the possibility that social desirability and demand characteristics may also have impacted self-reports of mood symptoms, alcohol and substance use, and sleep problems.

Finally, this study used a measure of adherence problems, rather than a direct measure of adherence itself. While the MMAS-8 has been shown to be highly sensitive to poor adherence

(Morisky et al., 2008), it may be the case that it does not map precisely onto other metrics of suboptimal adherence (e.g., missed doses).

Future Directions

The results of our study emphasize the importance of studying adherence problems among community populations, particularly under-studied demographics like young adults. Given the uniqueness of our sample, additional research is also necessary to extend these findings to other young adults, and identify potential risk factors for poor adherence among college men, as well as emerging adults outside a university setting.

The high rates of problems with adherence in our sample suggest that adherence among emerging adults is a significant clinical concern, but may be likely to go undetected in community samples of generally healthy individuals. This is particularly problematic given the serious consequences associated with poor adherence among young women, including illness progression, unintended pregnancy, and poor disease management (Adolescent and Young Adult Oncology Progress Review Group, 2014; Axelsson et al., 2009; Dobbels et al., 2010; Finer & Zolna, 2011). Future research is needed to develop and test screening procedures for identifying poor adherence among college women and other young adults. By identifying patients who may be at risk for suboptimal adherence, prescribers can provide greater support around medication-taking behaviors. The high rates of adherence problems observed in this sample, and the growing literature on the emergence of health behavior trajectories in young adulthood suggests that emerging adulthood may be an optimal time to deliver adherence interventions in order to maximize their long-term effectiveness.

Adherence has been described as “the most important therapeutic factor” for patients taking prescription medications (Arlt, Linder, Rosler, & von Renteln-Kruse, 2008, p.1034), and

meta-analytic evidence suggests that improving medication adherence may have a greater impact on clinical outcomes than novel treatment advances (Haynes, Ackloo, Sahota, McDonald, & Yao, 2008). As such, understanding barriers to adherence can help to improve clinical practice and inform future interventions. Interventions tailored to the risk factors most relevant for young women, including concerns about their medications, perceived barriers, poor executive functioning, psychological distress, or poor social support may prove be more effective than interventions developed for other populations.

Finally, as noted above, future research should prioritize longitudinal studies that assess the relationships between risk factors and adherence over time. To date, nearly all the adherence literature for young adults is based on cross-sectional data, which limits our ability to understand causal processes and the potential bidirectional relationships between psychosocial factors and health behaviors.

Conclusions

Convergent lines of evidence have suggested that emerging adulthood may be a time during which individuals, particularly young women, are at increased risk for poor medication adherence and associated health problems. This study sought to identify potential risk factors for adherence problems among a large sample of college women via an extensive online survey. Among college women, a number of factors were associated with adherence problems, including Hispanic/Latina identity, concerns about the long-term safety and effectiveness of their medications, perceived barriers to consistent adherence, poor executive functioning, psychosocial distress, and low levels of social support. Contrary to our hypotheses, regimen complexity, negative beliefs about medications broadly, greater alcohol and substance use, and sleep problems were not significantly associated with adherence problems. Our findings suggest

a unique set of risk factors for this population, highlighting the importance of studying medication adherence among young women. As medication becomes increasingly prevalent in our society and more and more young women are prescribed daily medication, understanding the factors that contribute to this important health behavior will become increasingly vital.

References

Adolescent and Young Adult Oncology Progress Review Group. (2014). *Closing the gap: Research and care implications for adolescents and young adults with cancer*.

Anthony, M., Lee, K. Y., Bertram, C. T., Abarca, J., Rehfeld, R. A., Malone, D. C., … Woosley, R. L. (2008). Gender and age differences in medications dispensed from a national chain drugstore. *Journal of Womens Health*, *17*(5), 735–743. http://doi.org/10.1089/jwh.2007.0731

Arlt, S., Linder, R., Rosler, A., & von Renteln-Kruse, W. (2008). Adherence to medication in patients with dementia: Predictors and strategies for improvement. *Drugs & Aging*, *25*(12), 1033–1047. http://doi.org/http://dx.doi.org/10.1007/s11096-011-9602-2

Arnett, J. J. (2000). Emerging adulthood:A theory of development from the late teens through the twenties. *American Psychologist*, *55*, 469–480. http://doi.org/10.1037//0003-066X.55.5.469

Arnett, J. J., Žukauskiene, R., & Sugimura, K. (2014). The new life stage of emerging adulthood at ages 18-29 years: Implications for mental health. *The Lancet Psychiatry*, *1*(7), 569–576. http://doi.org/10.1016/S2215-0366(14)00080-7

Arria, A. M., Caldeira, K. M., Allen, H. K., Vincent, K. B., Bugbee, B. A., & O'Grady, K. E. (2016). Drinking like an adult? Trajectories of alcohol use patterns before and after

college graduation. *Alcoholism: Clinical and Experimental Research*, *40*(3), 583–590. http://doi.org/10.1111/acer.12973

Axelsson, M., Emilsson, M., Brink, E., Lundgren, J., Torin, K., & Lotvall, J. (2009). Personality, adherence, asthma control and health-related quality of life in young adult asthmatics. *Respiratory Medicine*, *103*(7), 1033–1040. http://doi.org/10.1016/j.rmed.2009.01.013

Baek, R. N. (2014). *The Role of Executive Functioning and Prospective Memory in Subjective and Objective Measures of Medication Adherence among Adults with Type 2 diabetes*. *PhD Proposal*.

Bagner, D. M., Williams, L. B., Geffken, G. R., Silverstein, J. H., & Storch, E. A. (2007). Type 1 diabetes in youth: The relationship between adherence and executive functioning. *Children's Health Care*, *36*(2), 169–179. http://doi.org/10.1080/02739610701335001

Barclay, T. R., Hinkin, C. H., Castellon, S. A., Mason, K. I., Reinhard, M. J., & Marion, S. D. (2007). Age-associated predictors of medication adherence in HIV-positive adults: Health Beliefs, self-efficacy, and neurocognitive status. *Health Psychology*, *26*(1), 40–49. http://doi.org/10.1037/0278-6133.26.1.40.Age-Associated

Becker, S. L., Dezii, C. M., Burtcel, B., Kawabata, H., & Hodder, S. (2002). Young HIV-infected adults are at greater risk for medication nonadherence. *General Medicine*, *4*(3), 21. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12466764

Bender, B. G. (2006). Risk taking, depression, adherence, and symptom control in adolescents and young adults with asthma. *American Journal of Respiratory and Critical Care Medicine*, *173*(9), 953–957. http://doi.org/10.1164/rccm.200511-1706PP

Bergstrom, S.-E., Boman, G., Eriksson, L., Formgren, H., Foucard, T., Horte, L.-G., … Hedlin, G. (2008). Asthma mortality among Swedish children and young adults, a 10-year study.

Respiratory Medicine. http://doi.org/10.1016/j.rmed.2008.03.020

Bhatia, S., Landier, W., Shangguan, M., Hageman, L., Schaible, A. N., Carter, A. R., … Wong, F. L. (2012). Nonadherence to oral mercaptopurine and risk of relapse in hispanic and non-hispanic white children with acute lymphoblastic leukemia: A report from the Children's Oncology Group. *Journal of Clinical Oncology*, *30*(17), 2094–2101. http://doi.org/10.1200/JCO.2011.38.9924

Bosworth, H. B. (2011). *Medication Adherence: Making the Case for Increased Awareness*. *National Consumers League*. Retrieved from http://www.scriptyourfuture.org/wp-content/uploads/2014/02/NCLDuke_BriefingPaper_FINAL.pdf

Bryden, K. S., Dunger, D. B., Mayou, R. A., Peveler, R. C., & Neil, H. A. W. (2003). Poor prognosis of young adults with type 1 diabetes: A longitudinal study. *Diabetes Care*, *26*(4), 1052–1057. http://doi.org/10.2337/diacare.26.4.1052

Bryden, K. S., Peveler, R. C., Stein, A., Neil, A., Mayou, R. A., & Dunger, D. B. (2001). Clinical and psychological course of diabetes from adolescence to young adulthood: A longitudinal cohort study. *Diabetes Care*, *24*(9), 1536–40. http://doi.org/10.2337/diacare.24.9.1536

Butow, P., Palmer, S., Pai, A., Goodenough, B., Luckett, T., & King, M. (2010). Review of adherence-related issues in adolescents and young adults with cancer. *Journal of Clinical Oncology*. http://doi.org/10.1200/JCO.2009.22.2802

Buysse, D. J., Hall, M. L., Strollo, P. J., Kamarck, T. W., Owens, J., Lee, L., … Matthews, K. A. (2008). Relationships between the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and clinical/polysomnographic measures in a community sample. *Journal of Clinical Sleep Medicine*, *4*(6), 563–571.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index (PSQI): A new instrument for psychiatric practice and research. *Psychiatry Research, 28*, 193–213.

Canner, J., Alonzo, T. A., Franklin, J., Freyer, D. R., Gamis, A., Gerbing, R. B., … Horan, J. (2013). Differences in outcomes of newly diagnosed acute myeloid leukemia for adolescent/young adult and younger patients: A report from the Children's Oncology Group. *Cancer*, *119*(23), 4162–4169. http://doi.org/10.1002/cncr.28342

Chen, S.-L., Lee, W.-L., Liang, T., & Liao, I.-C. (2014). Factors associated with gender differences in medication adherence: A longitudinal study. *Journal of Advanced Nursing*, (January), 1–10. http://doi.org/10.1111/jan.12361

Cho, D. (2016). *Health Behaviors Changes from Adolescence to Emerging Adulthood: A Multilevel Modeling Perspective*. Retrieved from http://digitalcommons.uconn.edu/dissertations/1050/

Chowdhury, R., Khan, H., Heydon, E., Shroufi, A., Fahimi, S., Moore, C., … Franco, O. H. (2013). Adherence to cardiovascular therapy: A meta-analysis of prevalence and clinical consequences. *European Heart Journal*, *34*(38), 2940–8. http://doi.org/10.1093/eurheartj/eht295

Ciszewski, S., Francis, K., Mendella, P., Bissada, H., & Tasca, G. A. (2014). Validity and reliability of the Behavior Rating Inventory of Executive Function - Adult Version in a clinical sample with eating disorders. *Eating Behaviors*, *15*(2), 175–181.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385–396.

Coleman, C. I., Limone, B., Sobieraj, D. M., Lee, S., Roberts, M. S., Kaur, R., & Alam, T.

(2012). Dosing frequency and medication adherence in chronic disease. *Journal of Managed Care and Specialty Pharmacy*, *18*(7), 527–539.

Danziger-Isakov, L., Frazier, T. W., Worley, S., Williams, N., Shellmer, D., Dharnidharka, V. R., … CTOTC-05 Consortium. (2016). Perceived barriers to medication adherence in pediatric and adolescent solid organ transplantation. *Pediatric Transplantation*, *20*(2), 307–15. http://doi.org/10.1111/petr.12648

Daw, J., Margolis, R., & Wright, L. (2017). Emerging adulthood, emergent health lifestyles: Sociodemographic determinants of trajectories of smoking, binge drinking, obesity, and sedentary behavior. *Journal of Health and Social Behavior*. http://doi.org/10.1177/0022146517702421

Desai, M., & Oppenheimer, J. J. (2011). Medication adherence in the asthmatic child and adolescent. *Current Allergy and Asthma Reports*. http://doi.org/10.1007/s11882-011-0227-2

Diamond, A. (2014). Executive functions. *Annual Review of Clinical Psychology*, *64*, 135–168. http://doi.org/10.1146/annurev-psych-113011-143750.Executive

DiMatteo, M. R., Giordani, P. J., Lepper, H. S., & Croghan, T. W. (2002). Patient adherence and medical treatment outcomes: A meta-analysis. *Medical Care*, *40*(9), 794–811. http://doi.org/10.1097/01.MLR.0000024612.61915.2D

Dobbels, F., Ruppar, T., De Geest, S., Decorte, A., Van Damme-Lombaerts, R., & Fine, R. N. (2010). Adherence to the immunosuppressive regimen in pediatric kidney transplant recipients: A systematic review. *Pediatric Transplantation*, *14*(5), 603–613. http://doi.org/10.1111/j.1399-3046.2010.01299.x

Doggrell, S. A. (2010). Adherence to medicines in the older-aged with chronic conditions. *Drugs*

& Aging, *27*(3), 239–254. http://doi.org/10.2165/11532870-000000000-00000

Duke, D. C., & Harris, M. A. (2014). Executive function, adherence, and glycemic control in adolescents with type 1 diabetes: A literature review. *Current Diabetes Reports*. http://doi.org/10.1007/s11892-014-0532-y

Eaton, W. W., Muntaner, C., Smith, C., Tien, A., & Ybarra, M. (2004). Center for Epidemiologic Studies Depression Scale: Review and revision (CESD and CESDR). In *The use of psychological testing for treatment planning and outcomes assessment. Vol 3: Instruments for adults* (Vol. III, pp. 363–378).

Ettenhofer, M. L., Hinkin, C. H., Castellon, S. A., Durvasula, R., Ullman, J., Lam, M., … Foley, J. (2009). Aging, neurocognition, and medication adherence in HIV infection. *The American Journal of Geriatric Psychiatry*, *17*(4), 281–90. http://doi.org/10.1097/JGP.0b013e31819431bd

Finer, L. B., & Zolna, M. R. (2011). Unintended pregnancy in the United States: Incidence and disparities, 2006. *Contraception*, *84*(5), 478–485. http://doi.org/10.1016/j.contraception.2011.07.013

Finer, L. B., & Zolna, M. R. (2014). Shifts in intended and unintended pregnancies in the United States, 2001-2008. *American Journal of Public Health*. http://doi.org/10.2105/AJPH.2013.301416

Fischer, M. A., Stedman, M. R., Lii, J., Vogeli, C., Shrank, W. H., Brookhart, M. A., & Weissman, J. S. (2010). Primary medication non-adherence: Analysis of 195,930 electronic prescriptions. *Journal of General Internal Medicine*, *25*(4), 284–290. http://doi.org/10.1007/s11606-010-1253-9

Fontanella, C. A., Bridge, J. A., Marcus, S. C., & Campo, J. V. (2011). Factors associated with

antidepressant adherence for Medicaid-enrolled children and adolescents. *The Annals of Pharmacotherapy*, *45*(7–8), 898–909. http://doi.org/10.1345/aph.1Q020

Foster, B. J., Dahhou, M., Zhang, X., Dharnidharka, V., Ng, V., & Conway, J. (2015). High risk of graft failure in emerging adult heart transplant recipients. *American Journal of Transplantation*, *15*(12), 3185–3193. http://doi.org/10.1111/ajt.13386

Foster, B. J., & Pai, A. L. H. (2014). Adherence in adolescent and young adult kidney transplant recipients. *Open Urology & Nephrology Journal*, *7*(2), 133–143. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.896.3130&rep=rep1&type=pdf

Frech, A. M. (Ohio S. U. (2009). *Healthy behaviour trajectories between adolescence and emerging adulthood*. *Health (San Francisco)*. Retrieved from https://etd.ohiolink.edu/rws_etd/document/get/osu1241733569/inline

Fredericks, E. M. (2008). Nonadherence and the transition to adulthood. *Liver Transplantation*, *15*, S63-69. http://doi.org/10.1002/lt.

Fredericks, E. M., Magee, J. C., Opipari-Arrigan, L., Shieck, V., Well, A., & Lopez, M. J. (2008). Adherence and health-related quality of life in adolescent liver transplant recipients. *Pediatric Transplantation*, *12*(3), 289–299. http://doi.org/10.1111/j.1399-3046.2008.00901.x

Friedman, H. S., Navaratnam, P., & McLaughlin, J. (2010). Adherence and asthma control with mometasone furoate versus fluticasone propionate in adolescents and young adults with mild asthma. *Journal of Asthma*. http://doi.org/10.1080/02770903.2010.513076

Gadkari, A. S., & McHorney, C. a. (2010). Medication nonfulfillment rates and reasons: narrative systematic review. *Current Medical Research and Opinion*, *26*(3), 683–705.

Gellad, W. F., Grenard, J. L., & Marcum, Z. A. (2011). A systematic review of barriers to

medication adherence in the elderly: Looking beyond cost and regimen complexity. *American Journal of Geriatric Pharmacotherapy*. http://doi.org/10.1016/j.amjopharm.2011.02.004

George, J., & Shalansky, S. J. (2007). Predictors of refill non-adherence in patients with heart failure. *British Journal of Clinical Pharmacology*. http://doi.org/10.1111/j.1365-2125.2006.02800.x

Golay, A. (2011). Pharmacoeconomic aspects of poor adherence: can better adherence reduce healthcare costs? *Journal of Medical Economics*, *14*(5), 594–608. http://doi.org/10.3111/13696998.2011.597808

González, P., & Borrayo, E. A. (2011). The role of physician involvement in Latinas' mammography screening adherence. *Women's Health Issues*, *21*(2), 165–170. http://doi.org/10.1016/j.whi.2010.09.001

Goodhand, J. R., Kamperidis, N., Sirwan, B., Macken, L., Tshuma, N., Koodun, Y., … Lindsay, J. O. (2013). Factors associated with thiopurine non-adherence in patients with inflammatory bowel disease. *Alimentary Pharmacology & Therapeutics*, *38*(9), 1097–108. http://doi.org/10.1111/apt.12476

Graça Pereira, M., Berg-Cross, L., Almeida, P., & Cunha Machado, J. (2008). Impact of family environment and support on adherence, metabolic control, and quality of life in adolescents with diabetes. *International Journal of Behavioral Medicine*, *15*(3), 187–193. http://doi.org/10.1080/10705500802222436

Griffith, G., Kumaraswami, T., Chrysanthopoulou, S. A., Mattocks, K. M., & Clark, R. E. (2017). Prescription contraception use and adherence by women with substance use disorders. *Addiction*. http://doi.org/10.1111/add.13840

Gutierrez-Colina, A. M., Eaton, C. K., Lee, J. L., Reed-Knight, B., Loiselle, K., Mee, L. L., … Blount, R. L. (2016). Executive functioning, barriers to adherence, and nonadherence in adolescent and young adult transplant recipients. *Journal of Pediatric Psychology*, *41*(7), 759–767. http://doi.org/10.1093/jpepsy/jsv107

Guttmacher-Institute. (2016). *Unintended Pregnancy in the United States* (Vol. (2016)). Retrieved from http://www.guttmacher.org/pubs/journals/3002498.html

Hanghøj, S., & Boisen, K. A. (2014). Self-reported barriers to medication adherence among chronically ill adolescents: A systematic review. *Journal of Adolescent Health*. http://doi.org/10.1016/j.jadohealth.2013.08.009

Harden, P. N., Walsh, G., Bandler, N., Bradley, S., Lonsdale, D., Taylor, J., & Marks, S. D. (2012). Bridging the gap: An integrated paediatric to adult clinical service for young adults with kidney failure. *Bmj*, *344*(01), e3718–e3718. http://doi.org/10.1136/bmj.e3718

Hayes D., J., McCoy, K. S., Whitson, B. A., Mansour, H. M., & Tobias, J. D. (2015). High-risk age window for mortality in children with cystic fibrosis after lung transplantation. *Pediatric Transplantation*. http://doi.org/10.1111/petr.12401

Haynes, R. B., Ackloo, E., Sahota, N., McDonald, H. P., & Yao, X. (2008). Interventions for enhancing medication adherence. *Cochrane Database of Systematic Reviews*.

Haynes, R. B., McDonald, H., Garg, A. X., & Montague, P. (2002). Interventions for helping patients to follow prescriptions for medications.[update of Cochrane Database Syst Rev. 2000;(2):CD000011; PMID: 10796686]. *Cochrane Database of Systematic Reviews.*, (2), CD000011.

Henin, A., & Berman, N. (2016). The promise and peril of emerging adulthood: Introduction to the special issue. *Cognitive and Behavioral Practice*.

http://doi.org/10.1016/j.cbpra.2016.05.005

Hilliard, M. E., Wu, Y. P., Rausch, J., Dolan, L. M., & Hood, K. K. (2013). Predictors of deteriorations in diabetes management and control in adolescents with type 1 diabetes. *Journal of Adolescent Health, 52*(1), 28–34. http://doi.org/10.1016/j.jadohealth.2012.05.009

Hinkin, C. H., Hardy, D. J., Mason, K. I., Castellon, S. A., Durvasula, R. S., Lam, M. N., & Stefaniak, M. (2004). Medication adherence in HIV-infected adults: Effect of patient age, cognitive status, and substance abuse. *AIDS, 18 Suppl 1,* S19-25. http://doi.org/00002030-200418001-00004 [pii]

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics, 6*(6), 65–70. http://doi.org/10.2307/4615733

Holt, E., Joyce, C., Dornelles, A., Morisky, D., Webber, L. S., Muntner, P., & Krousel-Wood, M. (2013). Sex differences in barriers to antihypertensive medication adherence: Findings from the cohort study of medication adherence among older adults. *Journal of the American Geriatrics Society, 61*(4), 558–564.

Hood, K. K., Peterson, C. M., Rohan, J. M., & Drotar, D. (2009). Association between adherence and glycemic control in pediatric type 1 diabetes: A meta-analysis. *Pediatrics, 124*(6), e1171–e1179. http://doi.org/10.1542/peds.2009-0207

Horne, R., Weinman, J., & Hankins, M. (1999). The Beliefs about Medicines Questionnaire: The development and evaluation of a new method for assessing the cognitive representation of medication. *Psychology and Health, 14,* 1–24.

Howard, A. L., Galambos, N. L., & Krahn, H. J. (2010). Paths to success in young adulthood from mental health and life transitions in emerging adulthood. *International Journal of*

Behavioral Development. http://doi.org/10.1177/0165025410365803

Hughes, C. M. (2004). Medication non-adherence in the elderly: How big is the problem? *Drugs and Aging*, *21*(12), 793–811. http://doi.org/10.2165/00002512-200421120-00004

IMS Institute for Healthcare Informatics. (2016). *Medicines Use and Spending in the U.S. Medicines Use and Spending in the US: A review of 2015 and outlook to 2020*. Retrieved from www.theimsinstitute.org

Ingersoll, K. S., & Cohen, J. (2008). The impact of medication regimen factors on adherence to chronic treatment: A review of literature. *Journal of Behavioral Medicine*. http://doi.org/10.1007/s10865-007-9147-y

Kennard, B. D., Stewart, S. M., Olvera, R., Bawdon, R. E., hAilin, A. O., Lewis, C. P., & Winick, N. J. (2004). Nonadherence in adolescent oncology patients: Preliminary data on psychological risk factors and relationships to outcome. *Journal of Clinical Psychology in Medical Settings*. http://doi.org/10.1023/B:JOCS.0000016267.21912.74

Labig Jr., C. E., Zantow, K., & Peterson, T. O. (2005). Factors affecting students' medicine-taking habits. *Journal of American College Health*, *54*(3), 177–183. http://doi.org/10.3200/JACH.54.3.177-184

Lee, J. L., Eaton, C., Gutiérrez-Colina, A. M., Devine, K., Simons, L. E., Mee, L., & Blount, R. L. (2014). Longitudinal stability of specific barriers to medication adherence. *Journal of Pediatric Psychology*, *39*(7), 667–676. http://doi.org/10.1093/jpepsy/jsu026

Lee, M., & Khan, M. M. (2016). Gender differences in cost-related medication non-adherence among cancer survivors. *Journal of Cancer Survivorship*, *10*(2), 384–393. http://doi.org/10.1007/s11764-015-0484-5

Lehmann, A., Aslani, P., Ahmed, R., Celio, J., Gauchet, A., Bedouch, P., … Schneider, M. P.

(2014). Assessing medication adherence: Options to consider. *International Journal of Clinical Pharmacy*, *36*(1), 55–69. http://doi.org/10.1007/s11096-013-9865-x

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Health*, *46*(2), 124–132. http://doi.org/10.1016/j.jadohealth.2009.06.016

Macdonell, K. K., Carcone, A. I., Naar-King, S., Gibson-Scipio, W., & Lam, P. (2015). African American emerging adults' perspectives on taking asthma controller medication: Adherence in the "age of feeling in-between." *Journal of Adolescent Research*, *30*(5), 607–624. http://doi.org/10.1177/0743558414561299

MacLaughlin, E. J., Raehl, C. L., Treadway, Angela, K., Sterling, T. L., Zoller, D. P., & Bond, Chester, A. (2005). Assessing medication adherence in the elderly: Which tools to use in clinical practice? *Drugs & Aging*, *22*(3), 231–255.

Magrin, M. E., D'Addario, M., Greco, A., Miglioretti, M., Sarini, M., Scrignaro, M., … Crocetti, E. (2015). Social support and adherence to treatment in hypertensive patients: A meta-analysis. *Annals of Behavioral Medicine*, *49*(3), 307–318. http://doi.org/10.1007/s12160-014-9663-2

Mansyur, C. L., Rustveld, L. O., Nash, S. G., & Jibaja-Weiss, M. L. (2015). Social factors and barriers to self-care adherence in Hispanic men and women with diabetes. *Patient Education and Counseling*, *98*(6), 805–810. http://doi.org/10.1016/j.pec.2015.03.001

Mausbach, B. T., Schwab, R. B., & Irwin, S. A. (2015). Depression as a predictor of adherence to adjuvant endocrine therapy (AET) in women with breast cancer: A systematic review and meta-analysis. *Breast Cancer Research and Treatment*. http://doi.org/10.1007/s10549-015-3471-7

McCormick King, M. L., Mee, L. L., Gutierrez-Colina, A. M., Eaton, C. K., Lee, J. L., & Blount, R. L. (2014). Emotional functioning, barriers, and medication adherence in pediatric transplant recipients. *Journal of Pediatric Psychology*, *39*(3), 283–293. http://doi.org/10.1093/jpepsy/jst074

McGrady, M. E., Brown, G. A., & Pai, A. L. H. (2015). Medication adherence decision-making among adolescents and young adults with cancer. *European Journal of Oncology Nursing : The Official Journal of European Oncology Nursing Society*, *20*. http://doi.org/10.1016/j.ejon.2015.08.007

McGrady, M. E., & Hommel, K. A. (2013). Medication adherence and health care utilization in pediatric chronic illness: A systematic review. *Pediatrics*, *132*(4), 730–740. http://doi.org/10.1542/peds.2013-1451

McGrady, M. E., Peugh, J. L., & Hood, K. K. (2014). Illness representations predict adherence in adolescents and young adults with type 1 diabetes. *Psychol Health*, *29*(9), 985–998. http://doi.org/10.1080/08870446.2014.899361

McGrady, M. E., Williams, S. N., Davies, S. M., & Pai, A. L. H. (2014). Adherence to outpatient oral medication regimens in adolescent hematopoietic stem cell transplant recipients. *European Journal of Oncology Nursing*, *18*(2), 140–144. http://doi.org/10.1016/j.ejon.2013.11.007

McNally, K., Rohan, J., Pendley, J., Delamater, A., & Drotar, D. (2010). Executive Functioning , Treatment Adherence , and Glycemic Control in Children With Type 1 Diabetes. *Diabetes Care*, *33*(6), 1159–1162. http://doi.org/10.2337/dc09-2116.

McQuaid, E. L., Everhart, R. S., Seifer, R., Kopel, S. J., Mitchell, D. K., Klein, R. B., … Canino, G. (2012). Medication adherence among Latino and non-Latino white children with

asthma. *Pediatrics*, *129*(6), e1404-10. http://doi.org/10.1542/peds.2011-1391

Miller, T. A., & DiMatteo, M. R. (2013). Importance of family/social support and impact on adherence to diabetic therapy. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, *6*, 421–426. http://doi.org/10.2147/DMSO.S36368

Molloy, G. J., Graham, H., & McGuinness, H. (2012). Adherence to the oral contraceptive pill: A cross-sectional survey of modifiable behavioural determinants. *BMC Public Health*, *12*(1), 838. http://doi.org/10.1186/1471-2458-12-838

Morgan, S., & Kennedy, J. (2010). *Prescription drug accessibility and affordability in the United States and abroad. Issue brief (Commonwealth Fund)* (Vol. 89). Retrieved from http://www.commonwealthfund.org/~/media/Files/Publications/Issue Brief/2010/Jun/1408_Morgan_Prescription_drug_accessibility_US_intl_ib.pdf

Morisky, D. E., Ang, A., Krousel-Wood, M., & Ward, H. J. (2008). Predictive validity of a medication adherence measure in an outpatient setting. *Journal of Clinical Hypertension*, *10*(5), 348–354. http://doi.org/10.1111/j.1751-7176.2008.07572.x

Mumford, E. A., Liu, W., Hair, E. C., & Yu, T. C. (2013). Concurrent trajectories of BMI and mental health patterns in emerging adulthood. *Social Science and Medicine*, *98*, 1–7. http://doi.org/10.1016/j.socscimed.2013.08.036

Nasseh, K., Frazee, S. G., Visaria, J., Vlahiotis, A., & Tian, Y. (2012). Cost of medication nonadherence associated with diabetes, hypertension, and dyslipidemia. *American Journal of Pharmacy Benefits*, *4*(2), 41–47.

National Center for Health Statistics. (2016). *Health, United States, 2016: with Chartbook on long-term trends in health*.

Nelson, M. C., Story, M., Larson, N. I., Neumark-Sztainer, D., & Lytle, L. A. (2008). Emerging

adulthood and college-aged youth: An overlooked age for weight-related behavior change. *Obesity*, *16*(10), 2205–2211. http://doi.org/10.1038/oby.2008.365

Nunes, V., Neilson, J., O'Flynn, N., Calvert, N., Kuntze, S., Smithson, H., … J, S. (2009). *Clinical guidelines and evidence review for medicines adherence: Involving patients in decisions about prescribed medicines and supporting adherence*. London. Retrieved from http://www.nice.org.uk/nicemedia/pdf/CG76FullGuideline.pdf

O'Connor, P. J. (2006). Improving medication adherence. *Archives of Internal Medicine*, *166*(17), 1802. http://doi.org/10.1001/archinte.166.17.1802

O'Hara, L. K., & Holmbeck, G. N. (2013). Executive functions and parenting behaviors in association with medical adherence and autonomy among youth with spina bifida. *Journal of Pediatric Psychology*, *38*(6), 675–687. http://doi.org/10.1093/jpepsy/jst007

Oliveira-Filho, A. D., Barreto-Filho, J. A., Neves, S. J. F., & Lyra Junior, D. P. De. (2012). Association between the 8-item Morisky Medication Adherence Scale (MMAS-8) and blood pressure control. *Arquivos Brasileiros de Cardiologia*, *99*(1), 649–58. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/22688844

Osterberg, L., & Blaschke, T. (2005). Adherence to medication. *New England Journal of Medicine*, *353*(5), 487–497. http://doi.org/10.1056/NEJMra050100

Pai, A., & Ostendorf, H. M. (2011). Treatment Adherence in Adolescents and Young Adults Affected by Chronic Illness During the Health Care Transition From Pediatric to Adult Health Care: A Literature Review. *Children's Health Care*, *40*(1), 16–33. http://doi.org/10.1080/02739615.2011.537934

Penkower, L., Dew, M. A., Ellis, D., Sereika, S. M., Kitutu, J. M. M., & Shapiro, R. (2003). Psychological distress and adherence to the medical regimen among adolescent renal

transplant recipients. *American Journal of Transplantation*, *3*(11), 1418–1425. http://doi.org/10.1046/j.1600-6135.2003.00226.x

Peterson, A. M., Takiya, L., & Finley, R. (2003). Meta-Analysis of trials of interventions to improve medication adherence. *Pharmacy Practice*, *60*, 657–665.

Puskas, C. M., Forrest, J. I., Parashar, S., Salters, K. A., Cescon, A. M., Kaida, A., … Hogg, R. S. (2011). Women and vulnerability to HAART non-adherence: A literature review of treatment adherence by gender from 2000 to 2011. *Current HIV/AIDS Reports*, *8*(4), 277–287. http://doi.org/10.1007/s11904-011-0098-0

Pyatak, E. A., Florindez, D., & Weigensberg, M. J. (2013). Adherence decision making in the everyday lives of emerging adults with type 1 diabetes. *Patient Preference and Adherence*, *7*, 709–718. http://doi.org/10.2147/PPA.S47577

Qato, D. M., Wilder, J., Schumm, L. P., Gillet, V., & Alexander, G. C. (2016). Changes in prescription and over-the-counter medication and dietary supplement use among older adults in the United States, 2005 vs 2011. *JAMA Internal Medicine*, *176*(4), 473–482. http://doi.org/10.1001/jamainternmed.2015.8581

Radloff, L. S. (1977). Center for Epidemiologic Studies Depression Scale (CES-D). *Applied Psychological Measurement 1:* Retrieved from /www.nimh.nih.gov

Rashid, J. R., Leath, B. A., Truman, B. I., Atkinson, D. D., Gary, L. C., & Manian, N. (2017). Translating Comparative Effectiveness Research Into Practice. *Journal of Public Health Management and Practice*, *23*(5), 468–476. http://doi.org/10.1097/PHH.0000000000000525

Reinert, D. F., & Allen, J. P. (2007). The alcohol use disorders identification test: An update of research findings. *Alcoholism: Clinical and Experimental Research*.

Riegel, B., Moelter, S. T., Ratcliffe, S. J., Pressler, S. J., De Geest, S., Potashnik, S., … Goldberg, L. R. (2011). Excessive daytime sleepiness is associated with poor medication adherence in adults with heart failure. *Journal of Cardiac Failure*, *17*(4), 340–348. http://doi.org/10.1016/j.cardfail.2010.11.002

Rolnick, S. J., Pawloski, P. A., Hedblom, B. D., Asche, S. E., & Bruzek, R. J. (2013). Patient Characteristics Associated with Medication Adherence. *Clinical Medicine & Research*, *11*(2), 54–65. http://doi.org/10.3121/cmr.2013.1113

Roth, R. M., Isquith, P. K., & Gioia, G. A. (2014). Assessment of executive functioning using the Behavior Rating Inventory of Executive Function (BRIEF). (A. Acevedo, Anderson, Anderson, Anderson, Anderson, Antshel, Antshel, Antshel, Baird, Baron, Beardmore, Beck, Beebe, Berg, Bernstein, Best, Biederman, Bourke, Burgess, Burmeister, Campbell, Capdevila-Brophy, Chan, Chang, Chapman, Chasnoff, Chevignard, Christ, Ed.)*Handbook of Executive Functioning.* Springer Science + Business Media. http://doi.org/10.1007/978-1-4614-8106-5

Roth, R. M., Lance, C. E., Isquith, P. K., Fischer, A. S., & Giancola, P. R. (2013). Confirmatory factor analysis of the Behavior Rating Inventory of Executive Function-Adult version in healthy adults and application to attention-deficit/hyperactivity disorder. *Archives of Clinical Neuropsychology*, *28*(5), 425–34. http://doi.org/10.1093/arclin/act031

Rothenberger, A., Becker, A., Breuer, D., & Döpfner, M. (2011). An observational study of once-daily modified-release methylphenidate in ADHD: Quality of life, satisfaction with treatment and adherence. *European Child and Adolescent Psychiatry*. http://doi.org/10.1007/s00787-011-0203-3

Scal, P., Davern, M., Ireland, M., & Park, K. (2008). Transition to adulthood: Delays and unmet

needs among adolescents and young adults with asthma. *Journal of Pediatrics*. http://doi.org/10.1016/j.jpeds.2007.10.004

Schaefer, M. R., Rawlinson, A. R., Wagoner, S. T., Shapiro, S. K., Kavookjian, J., & Gray, W. N. (2017). Adherence to attention-deficit/hyperactivity disorder medication during the transition to college. *Journal of Adolescent Health*, *60*(6), 706–713. http://doi.org/10.1016/j.jadohealth.2016.12.011

Schroder, W., Sommer, H., Gladstone, B. P., Foschi, F., Hellman, J., Evengard, B., & Tacconelli, E. (2016). Gender differences in antibiotic prescribing in the community: A systematic review and meta-analysis. *Journal of Antimicrobial Chemotherapy*, *71*(7), 1800–1806. http://doi.org/10.1093/jac/dkw054

Schuman-Olivier, Z., Weiss, R. D., Hoeppner, B. B., Borodovsky, J., & Albanese, M. J. (2014). Emerging adult age status predicts poor buprenorphine treatment retention. *Journal of Substance Abuse Treatment*, *47*(3), 202–212. http://doi.org/10.1016/j.jsat.2014.04.006

Schutte, C. (2006). *Medication adherence in the elderly: The predictive power of neuropsychological tests*. Central Michigan University.

Shi, L., Liu, J., Koleva, Y., Fonseca, V., Kalsekar, A., & Pawaskar, M. (2010). Concordance of adherence measurement using self-reported adherence questionnaires and medication monitoring devices. *PharmacoEconomics*.

Shifren, K., Furnham, A., & Bauserman, R. L. (2003). Emerging Adulthood in American and British Samples: Individuals' Personality and Health Risk Behaviors. *Journal of Adult Development*, *10*(2), 75–88. http://doi.org/10.1023/A:1022435714590

Simons, L. E., & Blount, R. L. (2007). Identifying barriers to medication adherence in adolescent transplant recipients. *Journal of Pediatric Psychology*, *32*(7), 831–844.

http://doi.org/10.1093/jpepsy/jsm030

Simpson, S. H., Eurich, D. T., Majumdar, S. R., Padwal, R. S., Tsuyuki, R. T., Varney, J., & Johnson, J. A. (2006). A meta-analysis of the association between adherence to drug therapy and mortality. *British Medical Journal*, *333*(7575), 15–18. http://doi.org/10.1136/on

Skoog, J., Midlöv, P., Borgquist, L., Sundquist, J., & Halling, A. (2014). Can gender difference in prescription drug use be explained by gender-related morbidity?: A study on a Swedish population during 2006. *BMC Public Health*, *14*(1), 329. http://doi.org/10.1186/1471-2458-14-329

Sundberg, R., Palmqvist, M., Tunsater, A., & Toren, K. (2009). Health-related quality of life in young adults with asthma. *Respiratory Medicine*. http://doi.org/10.1016/j.rmed.2009.04.023

Tan, X., Patel, I., & Chang, J. (2014). Review of the four item Morisky Medication Adherence Scale (MMAS-4) and eight item Morisky Medication Adherence Scale (MMAS-8). *Innovations in Pharmacy*, *5*(3). Retrieved from http://pubs.lib.umn.edu/innovations/vol5/iss3/5

Tanner, J. L. (2016). Mental health in emerging adulthood. In *The Oxford handbook of emerging adulthood.* (pp. 1–15). http://doi.org/10.1086/655106

The New England Healthcare Institute. (2009). Thinking outside the pillbox: A system-wide approach to improving patient medication adherence for chronic disease. *New England Healthcare Institute*, (August), 1–21. http://doi.org/10.1056/NEJMp1002305

Thorell, K., Skoog, J., Zielinski, A., Borgquist, L., & Halling, A. (2012). Licit prescription drug use in a Swedish population according to age, gender and socioeconomic status after

adjusting for level of multi-morbidity. *BMC Public Health*, *12*(1), 575. http://doi.org/10.1186/1471-2458-12-575

Tinker, S. C., Broussard, C. S., Frey, M. T., & Gilboa, S. M. (2015). Prevalence of prescription medication use among non-pregnant women of childbearing age and pregnant women in the United States: NHANES, 1999-2006. *Maternal and Child Health Journal*, *19*(5), 1097–1106. http://doi.org/10.1007/s10995-014-1611-z

Tomaszewski, M., White, C., Patel, P., Masca, N., Damani, R., Hepworth, J., … Williams, B. (2014). High rates of non-adherence to antihypertensive treatment revealed by high-performance liquid chromatography-tandem mass spectrometry (HP LC-MS/MS) urine analysis. *Heart*, *0*(1–7), 855–61. http://doi.org/10.1136/heartjnl-2013-305063

Topinkova, E., Baeyens, J. P., Michel, J. P., & Lang, P. O. (2012). Evidence-based strategies for the optimization of pharmacotherapy in older people. *Drugs and Aging*, *29*(6), 477–494. http://doi.org/10.2165/11632400-000000000-00000

Trussell, J., Henry, N., Hassan, F., Prezioso, A., Law, A., & Filonenko, A. (2013a). Burden of unintended pregnancy in the United States: Potential savings with increased use of long-acting reversible contraception. *Contraception*, *87*(2), 154–161. http://doi.org/10.1016/j.contraception.2012.07.016

Uthman, O. A., Magidson, J. F., Safren, S. A., & Nachega, J. B. (2014). Depression and adherence to antiretroviral therapy in low-, middle- and high-income countries: a systematic review and meta-analysis. *Current HIV/AIDS Reports*, *11*(3), 291–307. http://doi.org/10.1007/s11904-014-0220-1

Van Arendonk, K. J., James, N. T., Boyarsky, B. J., Garonzik-Wang, J. M., Orandi, B. J., Magee, J. C., … Segev, D. L. (2013). Age at graft loss after pediatric kidney transplantation:

Exploring the high-risk age window. *Clinical Journal of the American Society of Nephrology*. http://doi.org/10.2215/CJN.10311012

Viswanathan, M., Golin, C. E., Jones, C. D., Ashok, M., Blalock, S. J., Wines, R. C. M., … Lohr, K. (2012). Interventions to improve adherence to self-administered medications for chronic diseases in the United States: A systematic review. *Annals of Internal Medicine*, *157*, 785–795.

White, A., & Hingson, R. W. (2013). The burden of alcohol: Excessive alcohol consumption and related consequences among college students. *Alcohol Research: Current Reviews*, *35*(2), 201–218. http://doi.org/10.1136/emermed-2015-205295

Williams, A. B., Amico, K. R., Bova, C., & Womack, J. A. (2013). A proposal for quality standards for measuring medication adherence in research. *AIDS and Behavior*, *17*(1), 284–297. http://doi.org/10.1007/s10461-012-0172-7

World Health Organization (WHO). (2003). *Adherence to long-term therapies: Evidence for action*. Geneva, Switzerland.

Wu, J. P., Kusunoki, Y., Ela, E. J., & Barber, J. S. (2016). Patterns of contraceptive consistency among young adult women in southeastern Michigan: Longitudinal findings based on journal data. *Women's Health Issues*, *26*(3), 305–312. http://doi.org/10.1016/j.whi.2016.02.007

Yap, A. F., Thirumoorthy, T., & Kwan, Y. H. (2015). Systematic review of the barriers affecting medication adherence in older adults. *Geriatrics and Gerontology International*, 1–9. http://doi.org/10.1111/ggi.12616

Zhang, J. X., & Meltzer, D. O. (2016). Is there a gender difference in cost-related medication non-adherence? *Journal of Gerontology & Geriatric Research*, *5*(2), e137.

http://doi.org/10.4172/2167-7182.1000e137

Zhong, W., Maradit-Kremers, H., St. Sauver, J. L., Yawn, B. P., Ebbert, J. O., Roger, V. L., … Rocca, W. A. (2013). Age and sex patterns of drug prescribing in a defined American population. In *Mayo Clinic Proceedings* (Vol. 88, pp. 697–707). http://doi.org/10.1016/j.mayocp.2013.04.021

Table 1. Sample demographic characteristics

Characteristic	n or Mean	% or SD
Age (years)	M: 19.38	SD: 2.44
Race/Ethnicity		
White/European American	134	73.2%
Hispanic/Latina	25	13.7%
Asian/Asian American	22	12.0%
Black/African American	16	8.7%
Native American	1	0.5%
Something Else	4	2.2%
Multiracial	18	9.8%
Sexual Orientation		
Straight/Heterosexual	171	93.4%
Bisexual	9	4.9%
Lesbian	1	0.5%
Something Else	1	0.5%
Don't Know	1	0.5%
Education Level		
Freshman	72	39.3%
Sophomore	63	34.4%
Junior	37	20.2%
Senior	10	5.5%
Fifth Year	1	0.5%
Living Situation		
On Campus	152	83.1%
Off Campus	16	8.7%
At Home	15	8.2%
Family Income		
$10,000 or less	8	4.4%
$10,001 to $20,000	8	4.4%
$20,001 to $40,000	14	7.8%
$40,001 to $60,000	21	11.7%
$60,001 to $80,000	19	10.6%
Over $80,000	110	61.1%
Not Reported	3	1.6%
Health Insurance Coverage		
Private, through family	119	65.0%
Private, through work	29	15.8%
Private, through school	6	3.3%
Public (e.g., Medicaid)	27	14.9%
Not Reported	2	1.0%

Table 1 *cont.*

Characteristic	n or Mean	% or SD
Employment Status		
Full Time	1	0.5%
Part Time	73	39.9%
Summer Job	69	37.7%
Not Employed	39	21.3%
Not Reported	1	0.5%

Table 2. Participant Medication Usage

	n or Mean	% or SD
# of Daily Medications	M: 1.48	SD: 0.85
1	119	65.0%
2	44	24.0%
3	12	6.6%
4	3	1.6%
5	1	0.5%
7	1	0.5%
# of Total Medication Instructions	M: 2.66	SD: 2.19
Unpleasant Side Effects	24	14.2%
Pts Taking Medication for:		
Birth Control	144	78.7%
Chronic Medical Condition	27	14.8%
Mental Health Condition	31	16.9%
ADD/ADHD	12	6.6%
Sleep	3	1.6%
Another Reason	10	5.5%
Not Sure	0	0%

Table 3. Medication Characteristics

	N = 265 Medications	
	n or Mean	% or SD
Means of Administration		
By mouth, pill	249	94.0%
By mouth, liquid	1	0.4%
Inhaled	7	2.6%
Topical/Onto Skin	5	1.9%
Injected	2	0.8%
Another Method	1	0.4%
# of Instructions per Medication	M: 1.81	SD:1.14

Table 4. Summary of Risk Factor Variables

	N = 180 Mean or n	 SD or %
Beliefs About Medication		
Specific-Concerns	9.06	4.10
Specific-Necessity	10.87	5.57
General-Overuse	10.87	3.62
General-Harm	7.95	2.60
Perceived Barriers to Adherence	2.70	2.96
Depressive Symptoms	19.72	12.13
CES-D >=16	n = 85	46.1%
Perceived Stress	17.67	7.65
Social Support	31.54	5.40
Alcohol Use	6.13	3.81
AUDIT >=8	n = 45	24.6%
Substance Use	0.60	0.99
DAST-10 >= 3	n = 9	4.9%
Sleep Disturbance	20.19	5.24
DSM T-score > 60	n =10	5.6%
Sleep Quality	2.11	0.61
Daytime Dysfunction	3.59	1.29
Global Executive Functioning	109.19	27.24
Behavior Regulation	47.77	12.75
Metacognition	61.34	16.22

Table 5. MMAS-8 Results

	N = 180 n or Mean	 % or SD
Problem with Adherence		
Sometimes Forget	133	72.7%
Missed in Last Two Weeks	80	43.7%
Stopped Because Felt Worse	34	18.6%
Stopped Because Felt Better	20	10.9%
Forget to Bring	109	59.6%
Missed Yesterday	14	7.7%
Feel Hassled	41	22.4%
Trouble Remembering	75	40.9%
Total MMAS-8 Score	M: 3.30	SD: 1.71

Table 6. Associations between the adherence problems and medication-related variables

	Total # of Medications	Total # of Instructions	Concerns about Own Medications	Perceived Necessity of Medications	Beliefs about Medication Overuse	Beliefs about Medication Harmfulness	Total # of Barriers
MMAS-8 Score							
Pearson Correlation	-0.045	-0.005	0.225**	0.038	0.014	0.060	0.453**
Significance (2-tail)	*n.s.*	*n.s.*	0.004	*n.s.*	*n.s.*	*n.s.*	<0.001

* $p < 0.05$, ** $p < 0.01$

Table 7. Associations between the adherence problems and behavioral and psychosocial variables

	Psychological Distress	Social Support	Alcohol Use	Substance Use	Sleep Disturbance	Executive Dysfunction
MMAS-8 Score						
Pearson Correlation	0.263**	-0.205*	0.167*	0.103	0.151*	0.317**
Significance (2-tail)	0.001	0.008	0.042	*n.s.*	0.047	<0.001

* $p < 0.05$, ** $p < 0.01$

Table 8. Predicting Adherence (controlling for Hispanic/Latina ethnicity)

	ΔR^2	p	β	p
Beliefs About Medication Specific-Concerns	0.042	0.001	0.207	0.007*
Barriers to Adherence	0.160	< 0.001	0.401	< 0.001*
Psychological Distress	0.061	<0.001	0.250	0.001*
Social Support	0.037	0.005	-0.193	0.011*
Alcohol Use	0.024	0.007	0.155	0.057
Sleep Disturbance	0.018	0.020	0.135	0.073
Global Executive Functioning	0.087	< 0.001	0.300	< 0.001*

* significant after α-correction

Table 9. Hierarchical linear regression with all included risk factors

	R^2	β	p-value	ΔR^2	χ^2 for ΔR^2	p-value
Step 1	0.072	-----	-----	0.072	7.664	0.007
Hispanic/Latina		0.268	0.007			
Step 2	0.333	-----	-----	0.261	5.729	< 0.001
Concerns about Own Medications		0.072	n.s.			
Barriers to Adherence		0.416	<0.001			
Psychological Distress		0.134	n.s.			
Social Support		-0.059	n.s.			
Alcohol Use		0.109	n.s.			
Sleep Disturbance		-0.084	n.s.			
Global Executive Functioning		0.269	0.024			

Appendices

Appendix A. Re-Coding of Participant-Reported Reason for their Medication

Reported as "Another Reason"	n	Re-Coded Reason
Acne/Skincare	15	Chronic Medical Condition
Migraines/Headaches	3	Chronic Medical Condition
Thyroid Condition/Hypothyroidism	3	Chronic Medical Condition
Allergies	2	Chronic Medical Condition
Polycystic Ovarian Syndrome	2	Chronic Medical Condition
Immune support to compensate for a genetic condition	2	Chronic Medical Condition
Asthma	1	Chronic Medical Condition
Anemia	1	Chronic Medical Condition
Insulin Resistance	1	Chronic Medical Condition
Anxiety	1	Mental Health Condition
Anorexia Nervosa	1	Mental Health Condition

Appendix B. Matrix of Pearson's correlation coefficients for medication-related and clinical variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. MMAS-8	----	-0.045	-0.005	0.225**	0.038	0.014	0.060	0.453**	0.263**	-0.205**	0.167*	0.103	0.151*	0.317**
2. # of Medications		----	0.656**	0.229**	0.503**	-0.196*	-0.117	0.138	0.223**	-0.205**	0.007	0.087	0.161*	0.118
3. # of Instructions			----	0.133	0.413**	-0.076	-0.014	0.089	0.180*	-0.121	0.017	0.017	0.100	0.020
4. Concerns about Meds				----	0.591**	0.259**	0.361**	0.455**	0.473**	-0.290**	0.124	0.114	0.352**	0.451**
5. Perceived Necessity					----	0.083	0.007	0.356**	0.369**	-0.276**	-0.018	0.044	0.417**	0.298**
6. Beliefs – Overuse						----	0.602**	0.121	0.172*	0.003	0.141	0.087	0.108	0.159
7. Beliefs – Harmfulness							----	0.035	0.232**	-0.261**	0.161	0.111	0.135	0.262**
8. # of Barriers								----	0.370**	-0.134	0.094	0.036	0.331**	0.446**
9. Psych. Distress									----	-0.518**	0.154	0.114	0.627**	0.652**
10. Social Support										----	0.043	-0.107	-0.309**	-0.435**
11. Alc. Use											----	0.165*	-0.068	0.193*
12. Sub. Use												----	-0.007	0.039
13. Sleep Disturbance													----	0.510**
14. Executive Dysfunction														----

* $p < 0.05$, ** $p < 0.05$